

Notice SS-01  
Effective 7/1/2003

Effective 7/1/03, Emergency Preparedness restructured the Shift Superintendent position. The risks and hazards on the site have decreased to the point that there is no longer a requirement for continuous Shift Superintendent coverage. Required actions are unchanged, while the pool of personnel who may be called upon to perform the actions is expanded.

Accordingly, one or more of the following, consistent with their existing responsibilities, may perform activities assigned to the Shift Superintendent in this document:

- Shift Superintendent
- Project Managers
- Facility Managers
- Configuration Control Authorities (CCAs)
- The Fire Department
- Fire Dispatch
- WSLLC

This activity reassignment should be formally incorporated into this document in the next revision.



**ROCKY FLATS ENVIRONMENTAL  
TECHNOLOGY SITE**

**PRO-1468-HASP-01**

**Environmental Restoration Program  
Health and Safety Plan  
for the  
Rocky Flats Environmental Technology Site**

10808 Highway 93  
Golden, CO 80403-8200

Revision 0  
September 7, 2001

Document Classification  
Review Waiver per  
Classification Office

09-7-01

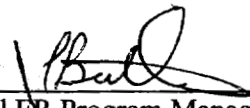
**PADC-2001-00497**

## ADMINISTRATIVE INFORMATION

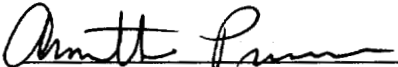
Site: Rocky Flats Environmental Technology Site (RFETS), Golden, Colorado  
Project Name: Environmental Restoration Program  
Date Prepared: September 2001

### Approvals

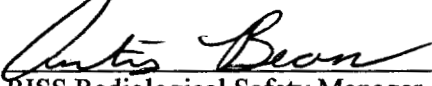
I have read and approved this HASP with respect to project hazards and regulatory requirements.

  
Kaiser-Hill ER Program Manager  
Lane Butler

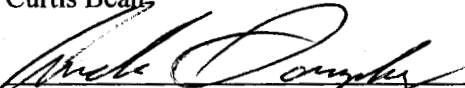
9/13/01  
Date

  
Kaiser-Hill Field Operations Manager  
Annette Primrose

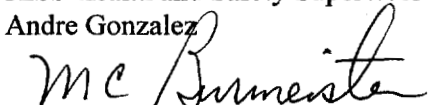
9-07-01  
Date

  
RISS Radiological Safety Manager  
Curtis Bean

9/10/01  
Date

  
RISS Health and Safety Supervisor  
Andre Gonzalez

9/10/01  
Date

  
RISS Field Operations, Author  
Mark Burmeister

9/7/01  
Date

LIST OF EFFECTIVE PAGES

Page	Effective Date	Page	Effective Date
1-77	September 7, 2001		

Total Number of Pages: 77

The following changes are active for this document:  
None

## TABLE OF CONTENTS

<b>1.0 INTRODUCTION.....</b>	<b>1</b>
<b>2.0 SITE INFORMATION.....</b>	<b>2</b>
2.1 ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE (RFETS) .....	2
2.1.1 RFETS Location.....	2
2.1.2 RFETS Background.....	3
2.1.3 RFETS Operations .....	3
2.2 PROJECT SPECIFIC DESCRIPTION.....	3
2.3 JOB HAZARD ANALYSIS .....	3
<b>3.0 SCOPE OF WORK.....</b>	<b>4</b>
3.1 EXCAVATION OF CONTAMINATED SOIL AND DEBRIS .....	4
3.2 HANDLING, PACKAGING AND MANAGEMENT OF HAZARDOUS AND RADIOACTIVE WASTES AND MEDIA .....	5
3.3 SAMPLING ACTIVITIES.....	6
3.4 HEAVY EQUIPMENT OPERATION AND INSPECTION .....	7
3.5 SITE RECLAMATION.....	7
3.6 DECONTAMINATION OF EQUIPMENT .....	7
3.7 FOAMING, AND/OR GROUTING PROCESS WASTE LINES, SANITARY & STORM SEWERS, AND FOOTING DRAINS .....	8
3.8 SOIL TREATMENT .....	8
<b>4.0 PROJECT PERSONNEL RESPONSIBILITIES.....</b>	<b>8</b>
4.1 ALL PERSONNEL .....	9
4.2 K-H ENVIRONMENTAL RESTORATION PROGRAM MANAGER.....	9
4.3 FIELD OPERATIONS MANAGER.....	9
4.4 HEALTH AND SAFETY SUPERVISOR.....	10
4.5 PROJECT SITE SAFETY OFFICER (SSO) .....	10
4.6 HEALTH AND SAFETY SPECIALIST (HSS).....	11
4.7 FIELD SUPERVISOR .....	11
4.8 RADIOLOGICAL ENGINEER .....	12
4.9 RADIOLOGICAL SAFETY MANAGER .....	12
4.10 RADIOLOGICAL CONTROL TECHNICIANS (RCTS).....	13
4.11 ENVIRONMENTAL RESTORATION SUBCONTRACTORS.....	13
4.12 ON-SITE PERSONNEL AND VISITORS.....	14
<b>5.0 HAZARD ASSESSMENT.....</b>	<b>15</b>
5.1 CHEMICAL HAZARDS.....	15
<i>Table 5 Hazards Associated with Site Contaminants.....</i>	<i>17</i>
5.1.1 Volatile Organic Compounds (VOCs) .....	17
5.1.2 Metals.....	19
5.1.3 Other Chemical Hazards.....	21
<i>Table 5.1 - Physical and Chemical Characteristics of Chemicals of Concern.....</i>	<i>25</i>
<i>Table 5.1 (Continued) Physical and Chemical Characteristics of Chemicals of Concern.....</i>	<i>28</i>
5.2 RADIOLOGICAL HAZARDS.....	28
5.2.1 External Radiation Exposure.....	29

5.2.2	<i>Internal Radiation Exposure</i> .....	30
5.2.3	<i>Uranium</i> .....	30
5.2.4	<i>Americium</i> .....	31
5.2.5	<i>Plutonium</i> .....	32
	<i>Table 5.2 Physical Characteristics of Plutonium Metal</i> .....	32
	<i>Table 5.3 Radiological Properties of Important Plutonium Isotopes</i> .....	33
	<i>Table 5.4 How Plutonium Metal Reacts in Air</i> .....	33
	<i>Table 5.5 Physical and Chemical Characteristics of Radionuclides of Concern</i> .....	36
5.3	<b>BIOLOGICAL HAZARDS</b> .....	37
5.3.1	<i>Insects</i> .....	37
5.3.2	<i>Arachnids</i> .....	37
5.3.3	<i>Snakes</i> .....	37
5.3.4	<i>Mammals</i> .....	37
5.3.5	<i>Poisonous Plants</i> .....	38
5.3.6	<i>Bloodborne Pathogens</i> .....	38
5.4	<b>PHYSICAL HAZARDS</b> .....	38
5.4.1	<i>Heavy Equipment Hazards</i> .....	38
5.4.2	<i>Excavation Hazards</i> .....	39
5.4.3	<i>Aerial Manlift Hazards</i> .....	40
5.4.4	<i>Noise Exposure Hazards</i> .....	41
5.4.5	<i>Heat Stress Hazards</i> .....	41
5.4.6	<i>Cold Stress Hazards</i> .....	44
5.4.7	<i>Personal Protective Equipment Hazards</i> .....	46
5.4.8	<i>Overhead Power Line Hazards</i> .....	46
5.4.9	<i>Vehicular Traffic Hazards</i> .....	47
5.4.10	<i>Portable Electric Generator Hazards</i> .....	47
5.4.11	<i>Hand Tool Hazards</i> .....	47
5.4.12	<i>Compressed Gas Hazards</i> .....	48
5.4.13	<i>Hoisting and Rigging Equipment Hazards</i> .....	48
5.4.14	<i>Fork Truck Hazards</i> .....	49
5.4.15	<i>Ladder Hazards</i> .....	49
5.4.16	<i>Elevated Work Hazards</i> .....	49
5.4.17	<i>Flammable or Combustible Liquid Storage Hazards</i> .....	50
5.4.18	<i>High Temperature, High Pressure Decontamination System Hazards</i> .....	50
5.4.19	<i>Hydraulic Powered Tools, Pneumatic Powered Tools and Compressor Hazards</i> .....	50
5.4.20	<i>Adverse Weather Conditions</i> .....	51
5.4.21	<i>Smoking, Alcohol, Drugs, and Firearms</i> .....	52
6.0	<b>PROJECT ORIENTATION AND TRAINING</b> .....	52
6.1	<b>SITE-SPECIFIC HEALTH AND SAFETY ORIENTATION</b> .....	52
6.2	<b>GENERAL SAFETY AND HEALTH TRAINING REQUIREMENTS</b> .....	53
6.3	<b>SAFETY TRAINING</b> .....	53
	<i>Table 6.1 Training Requirements</i> .....	54
7.0	<b>PERSONNEL PROTECTION EQUIPMENT</b> .....	58
8.0	<b>EXPOSURE MONITORING</b> .....	58
8.1	<b>NOISE MONITORING</b> .....	58

8.2	WIND SPEED MONITORING.....	58
8.3	HEAT STRESS MONITORING .....	59
8.4	COLD STRESS MONITORING .....	59
8.5	RADIOLOGICAL MONITORING .....	59
8.5.1	Equipment Monitoring.....	59
8.6	RESPIRABLE DUST MONITORING .....	59
8.7	COMBUSTION GASES MONITORING.....	60
	Table 8.1 Monitoring Program Summary .....	61
	Table 8.1 Monitoring Program Summary (Continued).....	62
9.0	CONTROL OF REMEDIATION SITE ACCESS.....	63
9.1	SITE CONTROL .....	63
10.0	CONSTRUCTION HEALTH AND SAFETY BULLETIN BOARD.....	64
11.0	SANITATION .....	64
12.0	EMERGENCY RESPONSE .....	64
12.1	SITE EVACUATION .....	64
12.2	EMERGENCY SERVICES.....	65
12.2.1	Emergency Phone Numbers.....	65
12.2.2	Rocky Flats Occupational Health Medical Facility (Building 122).....	65
	Table 12.1 Emergency Telephone Numbers.....	66
12.3	ACCIDENT/INJURY .....	67
12.3.1	Emergency Medical Procedures .....	67
12.3.2	Fire/Explosion.....	67
12.3.3	Natural Disasters .....	67
12.4	EMERGENCY EQUIPMENT .....	68
12.5	UNANTICIPATED HAZARDS OR CONDITIONS.....	69
13.0	SPILL CONTROL.....	69
13.1	SPILL RESPONSE PLANNING .....	69
13.2	INCIDENTAL SPILL OPERATION .....	69
13.3	EMERGENCY SPILL OPERATION .....	70
14.0	RECORD KEEPING REQUIREMENTS.....	71
14.1	DAILY HEALTH AND SAFETY MEETINGS .....	71
14.2	ACCIDENT/INCIDENT REPORTING.....	71
14.3	HEALTH AND SAFETY LOGBOOKS.....	72

## LIST OF FIGURES

Figure 4.1 Project Organization.....	15
--------------------------------------	----

## LIST OF APPENDICES

- Appendix A Sample HASP Addenda
- Appendix B Job Hazard Analysis
- Appendix C Project Personnel Phone List
- Appendix D Heat and Cold Stress Guidelines

## LIST OF REFERENCES

- American Conference of Governmental Industrial Hygienists Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, 1995-1996
- CRC (The Chemical Rubber Company) Handbook of Chemistry and Physics
- Department of Energy (DOE) DP-0123T, "Assessment of Plutonium Storage Safety Issues at DOE Facilities", January 1994
- Department of Energy (DOE) Order 5480.9A, Construction Project Safety and Health Management
- Department of Energy (DOE) Order 440.1A, Construction Project Safety and Health Management
- Department of Energy (DOE) Form F5480.4, Complaint Form
- Department of Energy (DOE) Form F5484.3, Individual Accident/Incident Report
- DOE Title 10 CFR 835 Occupational Radiation Protection
- NIOSH Pocket Guide to Chemical Hazards, 1994
- OSHA Title 29 CFR 1910 Safety and Health Regulations for General Industry
- OSHA Title 29 CFR 1926 Safety and Health Regulations for Construction
- PRO-W08-EP-6.16 Severe Weather Conditions
- MAN-066-COOP Rocky Flats Environmental Technology Site Conduct of Operations Manual
- MAN-071-IWCP Integrated Work Control Manual
- MAN-072-OS&IH PM Occupational Safety and Industrial Hygiene Program Manual
- RFETS Radiation Safety Practices Manual
- 1-15200-EPIP-12.11 Tornado Response
- 1-MAN-019-CMM-001 Chemical Management Manual
- 1-C90-EPR-SW.03 Containment of Spills within the Rocky Flats Drainages
- 1-D97-ADM-16.01 Administrative Procedure Manual - Occurrence Reporting Process
- 1-PRO-WGI-001 Waste Characterization, Generation, and Packaging
- 4-D99-WO-1100 Solid Radioactive Waste Packaging



## LIST OF ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
ACM	asbestos-containing material
AEC	Atomic Energy Commission
ALARA	As Low As Reasonably Achievable
CAMs	Continuous Air Monitors
CPM	Counts Per Minute
COCs	Contaminants of Concern
COOP	Conduct of Operations
dBA	Decibels
DOE	Department of Energy
DU	Depleted Uranium
EPA	Environmental Protection Agency
ER	Environmental Restoration
ERDA	Energy Research and Development Administration
FIDLER	Field Instrument for the Detection of Low Energy Radiation
GERT	General Employee Radiological Training
GFCI	Ground Fault Circuit Interrupter
HASP	Health and Safety Plan
HSS	Health and Safety Specialist
ISMS	Integrated Safety Management System
JHA	Job Hazard Analysis
K-H	Kaiser-Hill
MSDS	Material Safety Data Sheet
NIOSH	National Institute of Occupational Safety and Health
NO	nitric oxide
NO <sub>2</sub>	nitrogen dioxide
OSHA	Occupational Safety and Health Administration
PCE	tetrachloroethene
PEL	Permissible Exposure Limit
POD	Plan-of-the-Day
PPE	Personal Protective Equipment
P/WRE	Property/Waste Release Evaluation
RCT	Radiological Control Technician
RFETS	Rocky Flats Environmental Technology Site
RISS	Remediation, Industrial D&D, and Site Services
RWP	Radiological Work Permit
SCBA	self-contained breathing apparatus
SLM	Sound Level Meter
SSO	Site Safety Officer
TCE	trichloroethene
TLV	Threshold Limit Value
VOCs	volatile organic compounds
WBGT	Wet Bulb Globe Thermometer
UL	Underwriter's Laboratory
URMA	Underground Radioactive Material Area

## 1.0 INTRODUCTION

This site specific Health and Safety Plan (HASP) addresses the hazards associated with Environmental Restoration (ER) Program activities at the Rocky Flats Environmental Technology Site (RFETS) or Site, and establishes guidelines to protect project personnel, collocated workers, the general public, equipment, and the environment during the implementation of field activities.

ER Program activities at RFETS include the following:

- various sampling and characterization activities;
- excavation, removal, and treatment (if necessary) of contaminated soil and debris;
- erection of temporary structures and facilities;
- handling, packaging, and management of hazardous and radioactive wastes and media;
- heavy equipment operation;
- site reclamation/revegetation/regrading;
- equipment decontamination;
- tank and piping stabilization/foaming activities; and
- administrative activities.

ER supports the overall mission of reducing risk to future users of the site.

This plan incorporates Department of Energy (DOE) Title 10 CFR 835, "Occupational Radiation Protection," and Occupational Safety and Health Administration (OSHA) Title 29 CFR 1926.65 "Hazardous Waste Operations and Emergency Response". When not addressed in DOE Title 10 CFR 835 or OSHA Title 29 CFR 1926.65, all work will be performed in accordance with DOE Order 5480.9A, "Construction Project Safety and Health Management", OSHA Title 29 CFR 1910 "Safety and Health Regulations for General Industry" and/or OSHA Title 29 CFR 1926 "Safety and Health Regulations for Construction." These regulations require the development of a written comprehensive HASP.

The purpose of this plan is to establish personnel protection standards and mandatory worker safety and environmental protection procedures, designed to ensure compliance with the aforementioned regulations, and the appropriate DOE performance standards, such as As Low As Reasonably Achievable (ALARA), the Radiological Work Permit (RWP), the Job Hazard Analysis (JHA), and project Soil Disturbance Permits. This HASP incorporates current safety, training and work control programs, practices, and management systems with respect to implementing the Rocky Flats Conduct of Operations Program (COOP), and Integrated Safety Management System (ISMS).

COOP ensures that operations are conducted in a manner consistent with Site goals, objectives and approved procedures. When procedures are implemented properly, human errors are reduced and operations are

performed consistently. Failure to follow procedures could negatively affect the worker, public safety, equipment, productivity, and may violate the law.

The ISMS is the integration of safety into the management of projects and activities. The ISMS requires worker involvement when work is planned, performed, and managed. This helps to ensure that experience, concerns, skills and knowledge from the floor level up to senior management are considered. The ISMS has 5 core functions. The 5 core functions of ISMS are:

- Define the scope of work;
- Identify and analyze hazards;
- Identify and implement controls;
- Perform the work; and
- Provide feedback.

Because the RFETS ER program is evolving and government, local and Site regulations change, this plan is not static. This HASP will be reviewed and revised as needed. Regular review of the plan's progress and applicability is anticipated by responsible departments, and appropriate subject matter experts.

This HASP has been prepared with available information on the hazards known to be present at the RFETS. A Project Specific or Task Specific Addenda may be prepared to supplement this HASP and address additional information and hazards specific to that Project or Task.

Revisions to this HASP require approval from the Kaiser-Hill (K-H) ER Program Manager, K-H Field Operations Manager, Remediation, Industrial D&D, and Site Services (RISS) Radiological Safety Manager, and the RISS Health and Safety Supervisor (HSS).

This HASP applies to RFETS contractors, subcontractors, and visitors involved in operations, management, or administration of ER field activities. All users of this plan shall obtain a copy of the most recent revision prior to performing work at the site. Subcontractors will manage and perform work in accordance with a documented Safety Management System that complies with the K-H COOP and ISMS Programs. Prior to commencement of work, the subcontractor shall develop and implement plans for performing work safely on the Site by utilizing the five ISMS guiding principals.

## **2.0 SITE INFORMATION**

### **2.1 Rocky Flats Environmental Technology Site (RFETS)**

#### **2.1.1 RFETS Location**

RFETS is located in northern Jefferson County, Colorado, approximately 16 miles northwest of Denver. The cities of Boulder, Broomfield, Westminster, and Arvada are located less than 10 miles to the north, northeast, east, and southeast, respectively. RFETS consists of approximately 6,550 acres and occupies Sections 1

through 4 and 9 through 15 of Township 2 South, Range 70 West, 6th Principal Meridian. Major plant buildings are located within an RFETS security area of approximately 400 acres.

The present security area is surrounded by a buffer zone of approximately 6,150 acres. RFETS is generally bounded on the north by State Highway 128. To the east is Jefferson County Highway 17, also known as Indiana Street; to the south are agricultural and industrial properties, and State Highway 72; and to the west is State Highway 93.

### **2.1.2 RFETS Background**

RFETS is a government-owned and contractor-operated facility that is part of the nationwide nuclear weapons production complex. It was operated for the U. S. Atomic Energy Commission (AEC) from RFETS's inception in 1951, then known as the Rocky Flats Plant, until the AEC was dissolved in January 1975. Then, responsibility for Rocky Flats Plant was assigned to the Energy Research and Development Administration (ERDA), which was succeeded by the DOE in 1977. Dow Chemical USA, an operating unit of the Dow Chemical Company, was the managing and operating contractor of the facility from 1951 until June 30, 1975. Rockwell International succeeded Dow Chemical USA from July 1, 1975 to January 1, 1990. EG&G Rocky Flats, Inc. succeeded Rockwell International and operated the plant from January 1, 1990 to July 1, 1995. The plant name was changed to Rocky Flats Environmental Technology Site in 1994. The plant has been operated by the Kaiser-Hill Company, LLC, (K-H) since July 1, 1995.

### **2.1.3 RFETS Operations**

Prior to 1992, production activities included fabrication of nuclear weapons components from beryllium, plutonium, stainless steel, and uranium; assembly of components; and chemical recovery and purification of recyclable transuranic radionuclides. Nuclear weapons parts produced at RFETS were shipped off-site for assembly. Obsolete weapons parts fabricated at RFETS were returned for plutonium recovery processing. Other activities included research and development in metallurgy, machining, nondestructive testing, coatings, remote engineering, chemistry, and physics. The major classes of waste generated includes hazardous waste, radioactive waste, and mixed (hazardous and radioactive) waste. Currently, the mission at RFETS is decontaminating, decommissioning, and ER of the plant.

## **2.2 Project Specific Description**

A project specific HASP Addenda will be prepared (when necessary) to describe and address task and project specific hazards. Refer to the Project Specific HASP Addenda. An example has been provided in Appendix A of this HASP.

## **2.3 Job Hazard Analysis**

OSHA regulations (29 CFR 1910.132) require the employer to conduct JHAs for workplace specific activities and locations. Other provisions of the regulations require additional training on the proper use and limitations of the protective equipment. The purpose of these regulations is to ensure that employee personal protective equipment (PPE) is appropriate. Refer to Appendix B for information on preparing a JHA. This guidance explains how to study and record each step of a job, identify existing or potential job hazards, and

determine the best way to perform the job or reduce/eliminate the hazards. The JHA identifies the hazards associated with the particular activity and the mitigating measures to be taken to avoid and control the hazards. New JHAs will be developed as necessary, and included in the HASP Addenda.

### **3.0 SCOPE OF WORK**

The scope of work involves ER and remediation activities necessary for safe closure of RFETS. Task specific JHAs will be developed and included in the HASP Addenda.

Following is a list of general activities that may be required to accomplish all tasks of the ER Program. Activities which are specific to a given task will be addressed within each task section listed below.

- working under the stipulations of a RWP;
- wearing appropriate personal protective equipment;
- performing high volume and low volume radiological air monitoring (if required);
- performing radiological contamination surveys;
- maintaining and operating CAMs;
- performing radiation surveys as required;
- frisking personnel for radiological purposes;
- conducting real-time air monitoring for volatile organic compounds (VOCs), combustible gases, particulates, and diesel combustion by-products;
- conducting personal and area integrated air sampling as needed;
- monitoring personnel for noise and heat/cold stress exposure;
- spraying water to minimize dust;
- decontaminating equipment;
- performing personnel contamination control;
- managing waste such as disposable personal protective equipment; and
- securing the site at the end of each day.

#### **3.1 Excavation of Contaminated Soil and Debris**

This task includes the excavation, and removal of soil and debris from contamination release sites, burial trenches and pits, soil stockpiles, building structures and foundations, etc. Buried debris could include drums, drum carcasses, wood, metal, rubber, plastics, paper and glass, trash, concrete, asphalt, unknown materials, and suspected classified items. Soil and buried materials will typically be excavated utilizing mechanical equipment such as excavators, backhoes and/or front-end loaders. In some cases excavations

will proceed utilizing hand tools (i.e., rakes, shovels, spades). In all cases, the equipment operator must be trained and qualified on the specific piece of equipment he or she is operating.

A spotter will assist the equipment operator in positioning the excavation machinery, and watching for unanticipated hazards or conditions. All ground personnel communications with the excavator operator **SHALL** go through the spotter who will communicate with the operator using a hand-held radio and/or hand signals.

Other task specific activities required to accomplish safe excavation of drums, soil, debris, unknown materials, and suspected classified items are described in detail in Section 5.4.2, and include the following:

- positioning a full-time spotter to aid the operator and watch for unanticipated hazards or conditions;
- venting the excavator exhaust when necessary;
- inspecting and operating the mechanical excavation equipment;
- working around an open excavation;
- pumping groundwater from the excavation;
- proper design and installation of shoring and shielding;
- placing excavated material in containers or front end loader bucket;
- moving soil/debris with a front end loader;
- inspecting labels, markings, or other information on materials or containers with liquids and/or sludge which cannot be immediately identified; and
- isolation of suspected "classified" items, and notification of the RFETS Classification Office.

This task may also include backfill and compaction of soils at an excavation site. In most cases, the soil utilized for backfill is "clean" soil imported from an off-site commercial location. However, in all instances, the same industrial hazards exist with the use of mechanical equipment, open excavations, tripping/falling hazards, confined spaces, etc.

Prior to beginning any soil disturbance project, an initial characterization for radiological characteristics and chemical/heavy metal contamination **SHALL** be completed. Characterization of the excavation site can be accomplished utilizing process and/or historical knowledge, and/or site specific analytical data (if available). A Soil Disturbance Permit must be obtained in accordance with Chapter 45 of MAN-072-OS&IH PM, *Occupational Safety and Industrial Hygiene Program Manual* (OS&IH PM). A project specific JHA will be written to ensure all potential hazards have been considered.

### **3.2 Handling, Packaging and Management of Hazardous and Radioactive Wastes and Media**

Drums, soil, debris, unidentifiable material, and suspected classified items will be segregated and packaged according to identifiable waste types and the results of initial field characterization. To the extent possible,

all material should be segregated and packaged utilizing remote handling devices, such as excavator buckets, shovels, long-handled tongs, etc.

After waste containers have been sealed and labeled, they will be transported to a waste staging or storage area where they will be surveyed for unrestricted release. To ensure that the storage areas are posted correctly in regards to radiation levels, radiation surveys should be conducted prior to or immediately after the container movement.

Task specific activities required to handle, package and manage hazardous and radioactive waste and media include the following:

- overpacking or repacking of drums and containers;
- stabilizing/inerting the contents of a drum or container;
- performing field surveys/monitoring of wastes, media and containers using field instrumentation;
- packaging of waste and media for disposition;
- visual inspection of waste and debris for initial characterization;
- sealing and labeling of waste containers for proper management;
- conducting formal documented inspections of staging/storage areas at proper intervals;
- inspecting and operating forklifts and equipment;
- establishing roadways for forklift operations; and
- loading waste containers onto transports.

### **3.3 Sampling Activities**

When sufficient process knowledge and/or historical information is unavailable, then soils, wastes and media require sampling for characterization.

Task specific activities required to complete sampling activities may include the following:

- soil samples collected from a stockpile/excavation/borehole to determine the pre- and/or post-action condition of subsurface soils;
- sampling utilizing heavy equipment such as the excavator bucket;
- preparation of a Sample Release Evaluation in accordance with PRO-141-RSP-09.01, *Unrestricted Release of Property, Material, Equipment, and Waste*;
- decontaminating sampling equipment; and
- packaging and transport of the samples for shipment.

### **3.4 Heavy Equipment Operation and Inspection**

Operation of mechanical equipment may be utilized for a variety of reasons at the RFETS. Excavation equipment, trucks for the transport of containers, equipment and materials, cranes or other rigging devices, forklifts, and compaction devices (i.e. drum crushers, metal shredders, size-reduction equipment) are all likely pieces of equipment to be used during the course of the ER Program.

Task specific activities required to accomplish safe operation of mechanized equipment include the following:

- daily documented inspection of motorized equipment and tools;
- adequate maintenance of heavy equipment;
- spraying of water on the roadways to minimize airborne dust;
- utilization of breathing air cylinders on motorized equipment to allow the operator to wear an airline respirator for extended periods of time;
- instituting radiological controls depending on soil contaminants and the radiological conditions at the site; and
- establishing roadways to ensure the safe movement of motorized equipment.

### **3.5 Site Reclamation**

At the completion of a project, uncontaminated topsoil may be returned to the site. The topsoil may be graded and revegetated with an appropriate seed mixture in order to return it to an improved natural condition. The seed mixture may be covered to prevent wind dispersal and promote germination.

Activities required to accomplish site reclamation may include the following:

- operating heavy equipment;
- instituting radiological controls depending on soil stockpile sampling results and the radiological conditions at the site;
- monitoring wind speed; and
- securing the site at the end of each day.

### **3.6 Decontamination of Equipment**

Materials and equipment may require decontamination prior to release from the project site and prior to unrestricted free release from RFETS to off site locations. Decontamination methods will vary depending on the location and extent of contamination and effectiveness will be determined by visual inspection, radiological monitoring, and volatile organic compound monitoring. At the discretion of the project



manager, items may be decontaminated in the field or transferred to the Main or B-966 Decontamination Facilities.

Activities required to decontaminate heavy equipment and materials include the following:

- staging heavy equipment;
- establishing a portable decontamination station with secondary containment;
- transferring items to the Main or B-966 Decontamination Facilities;
- spraying water at low or high pressures and/or wiping or scrubbing; and
- managing decontamination waste such as decontamination fluids, soils and sediments.

### **3.7 Foaming, and/or Grouting Process Waste Lines, Sanitary & Storm Sewers, and Footing Drains**

Flushing, foaming, and/or grouting of process waste lines, tanks, sanitary and storm sewers, and footing drains may be required to remove and/or immobilize contaminants.

Activities required for foaming, grouting and stabilization of piping and structures include the following:

- staging heavy equipment;
- confined space entry;
- pumping/removal and management of sludges and solids;
- low or high pressure injection of grouts/foam materials.

### **3.8 Soil Treatment**

If substantial quantities of soil, sludge or other materials are found to be contaminated with a hazardous and/or radioactive constituent(s), treatment may be necessary. Low vacuum low temperature thermal desorption or other equally effective technology may be used to treat the soil. If treatment is required, a separate HASP or addenda may be developed by the subcontractor for this evolution.

## **4.0 PROJECT PERSONNEL RESPONSIBILITIES**

The responsibilities and authorities of each individual relating to health and safety issues are presented below. The project Health and Safety Organization Chart is shown in Figure 4.1. The chart reflects an organization which may typically be used for a large remediation project. The graded approach shall be applied dependent upon the size of the project or task. An example project phone list is presented in Appendix C.

#### **4.1 All Personnel**

Each person is responsible for the health and safety of themselves and their coworkers, for completing tasks in a safe manner, and reporting any unsafe acts or unanticipated hazards or conditions to the Project Manager, SSO, or the HSS. All personnel are responsible for continuous adherence to this HASP during the performance of their work. No person may work in a manner that conflicts with the safety and environmental precautions expressed in this document.

#### **4.2 K-H Environmental Restoration Program Manager**

The K-H ER Program Manager or designee is responsible for the following:

- liaison activities between K-H ER management and Subcontractor Project management;
- setting priorities for ER field activities; and
- issuing approval for restart of the project following suspension of activities.

#### **4.3 Field Operations Manager**

The Field Operations Manager is responsible for overall operations during field work on the site including the health and safety of project personnel during site activities. The Field Operations Manager is responsible for implementation of this HASP and protecting surrounding facilities and any potentially affected communities. The Field Operations Manager shall ensure that work crews have adequate resources to effectively perform the tasks required, that proper personal protective equipment is being used (as specified in the HASP), and that disciplinary actions are enforced when health and safety requirements are not being followed or unsafe practices occur. The Field Operations Manager's specific health and safety duties include the following:

- managing the development and implementation of the project specific JHA;
- performing weekly documented on-site inspections to make certain that the HASP is being followed;
- coordinating with the SSO and HSS on health and safety matters;
- providing the appropriate monitoring and safety equipment necessary for implementing this HASP;
- suspending field activities if health and safety of personnel are endangered pending an evaluation by the SSO or the HSS;
- suspending field activities for radiological safety issues and consulting with Radiological Safety;
- suspending individuals from field activities for infractions of this HASP pending an evaluation by the SSO and/or the HSS;
- ensuring that proper controls and work practices are in place following any unanticipated hazard or condition including necessary changes to the HASP or JHA;
- escorting employees with injuries or illnesses to RFETS Medical;

- implementing emergency procedures as required; and
- assisting in accident investigations and implementing corrective actions to any unsafe conditions.

#### **4.4 Health and Safety Supervisor**

The HSS is responsible for overall compliance with and implementation of the HASP. The HSS's responsibilities are as follows:

- develop health and safety requirements for the project;
- assist in the development of the project specific JHAs;
- approve the project specific JHAs;
- approve all changes to the project specific JHAs;
- provide health and safety assistance to the SSO and HSS;
- perform weekly documented on-site inspections to make certain that the HASP and JHA are being followed;
- escorting employees with injuries or illnesses to RFETS Medical;
- provide health and safety oversight on the project;
- ensure prompt reporting of all accidents and incidents; and
- maintain all required health and safety statistical information pertinent to employee hours worked.

#### **4.5 Project Site Safety Officer (SSO)**

The SSO is responsible for project on-site compliance and implementation of the HASP. The specific health and safety duties of the SSO include the following:

- developing the site specific JHAs;
- reporting to the HSS and the Project Manager on health and safety matters;
- conducting health and safety orientation (or designee);
- providing a copy of the HASP to all field crews;
- ensuring that current medical clearance and training documentation is available;
- obtaining required health and safety equipment and maintaining equipment on the site;
- conducting daily pre-work health and safety briefings;
- conducting daily site health and safety inspections and immediately correcting deficiencies;
- supervising the Health and Safety Specialists;

- immediately reporting all safety-related incidents or accidents to the Health and Safety Supervisor and the Project Manager;
- overseeing or conducting required health and safety monitoring such as air contaminant, noise, and heat or cold stress monitoring;
- maintaining a health and safety log including monitoring results and observations;
- suspending work or otherwise limiting personnel exposures if this HASP appears to be unsuitable or inadequate, or if the health or safety of personnel is endangered;
- implementing emergency procedures as required; and
- ensuring prompt employee notification of air monitoring results and maintaining health and safety record for the life of the project.

#### **4.6 Health and Safety Specialist (HSS)**

This HASP and the project specific JHAs are implemented by the HSS. The specific health and safety duties of the HSS include the following:

- assisting the SSO in implementing the HASP and project specific JHAs;
- reporting to the SSO and the Field Supervisor on health and safety matters;
- assisting the SSO in conducting daily pre-work health and safety briefings;
- immediately reporting all safety-related incidents or accidents to the SSO and the Field Supervisor;
- conducting required health and safety monitoring such as air contaminant, noise, and heat or cold stress monitoring;
- maintaining a health and safety log including monitoring results and observations;
- directing personnel to change work practices if existing practices are deemed to be hazardous to the health and safety of personnel; and
- implementing emergency procedures as required.

#### **4.7 Field Supervisor**

The Field Supervisor, in coordination with the Project Manager and the SSO, will be responsible for the implementation of this HASP and the project specific JHAs. This will include communicating site requirements to all on-site project personnel. The duties of the Field Supervisor include the following:

- along with craft personnel, develop a written JHA for each task;
- enforcing the requirements of this HASP and the project specific JHAs;
- suspending work, as required, to ensure personal safety and protection of property, or where life or property-threatening non-compliance with safety requirements is found;

- ensuring the appropriate site permits are obtained before work begins at each site;
- notifying the Project Manager of any accidents, spills, or emergencies;
- informing facility personnel of activities that will be carried out on a particular day;
- communicating with the SSO about the schedule of work at the facility;
- ensuring that all site personnel have been given the proper medical clearance;
- ensuring that all site personnel have met appropriate training requirements and have the appropriate training documentation at the site;
- conducting daily site health and safety inspections and reporting all unsafe conditions to the SSO;
- implementing corrective actions to any unsafe conditions; and
- implementing emergency procedures as required.

#### **4.8 Radiological Engineer**

The Radiological Engineer is responsible for overseeing the development and implementation of and ensuring compliance with the radiological aspects of this HASP and the project specific JHAs. The Radiological Engineer's responsibilities are as follows:

- coordination of, or preparation of radiological input to the Soil Disturbance Permit;
- develop radiological guidelines for the project;
- oversee development of the RWP and postings;
- review the site specific JHAs and this HASP;
- prepare the project specific ALARA Job Review (as required);
- approve all changes to the this HASP;
- provide radiological assistance to the RCT;
- interpret radiological data and prepare Property/Waste Release Evaluations (PWREs);
- assure activities limit radiological exposures to levels that are ALARA; and
- ensure prompt reporting of all radiological incidents.

#### **4.9 Radiological Safety Manager**

The Radiological Safety Manager is responsible for overall compliance with and implementation of this HASP. The Radiological Safety Manager's responsibilities are as follows:

- develop radiological guidelines for the project;
- oversee development of the RWPs and postings;

- approve the HASP;
- approve all changes to the HASP;
- provide radiological assistance to the SSO, HSS, and RCTs;
- assure activities limit radiation exposures to levels that are ALARA;
- ensure prompt reporting of all radiological incidents; and
- maintain all required radiological survey information pertinent to the project.

#### **4.10 Radiological Control Technicians (RCTS)**

The RCTs will be responsible for implementation of this HASP. This includes communicating site radiological conditions to all onsite project personnel and consultation with the Field Supervisor and the Project Manager. The specific duties of the RCTs include the following:

- implementing radiological guidelines;
- preparing the RWP and posting the area appropriately as required;
- coordinating and documenting activities to limit radiation exposures to levels that are ALARA;
- performing contamination surveys of drums, debris, and equipment;
- performing Field Instrument for Detection of Low Energy Radiation (FIDLER) surveys;
- performing high volume and low volume radiological air monitoring (as required);
- maintaining the CAMs, when required;
- performing radiation surveys as required;
- performing contamination control surveys;
- frisking personnel as required;
- aiding personnel in the doffing of personal protective equipment;
- documenting and submitting formalized radiological surveys and air monitoring data to the Project Manager or Field Supervisor;
- maintaining a log of pertinent observations; and
- suspending work if health or safety of personnel or the environment is endangered.

#### **4.11 Environmental Restoration Subcontractors**

Subcontractors will implement and follow this HASP and project specific JHAs. Subcontractors must attend and participate in the daily Tailgate Safety Meetings and all other site safety meetings. The following specific responsibilities are included:

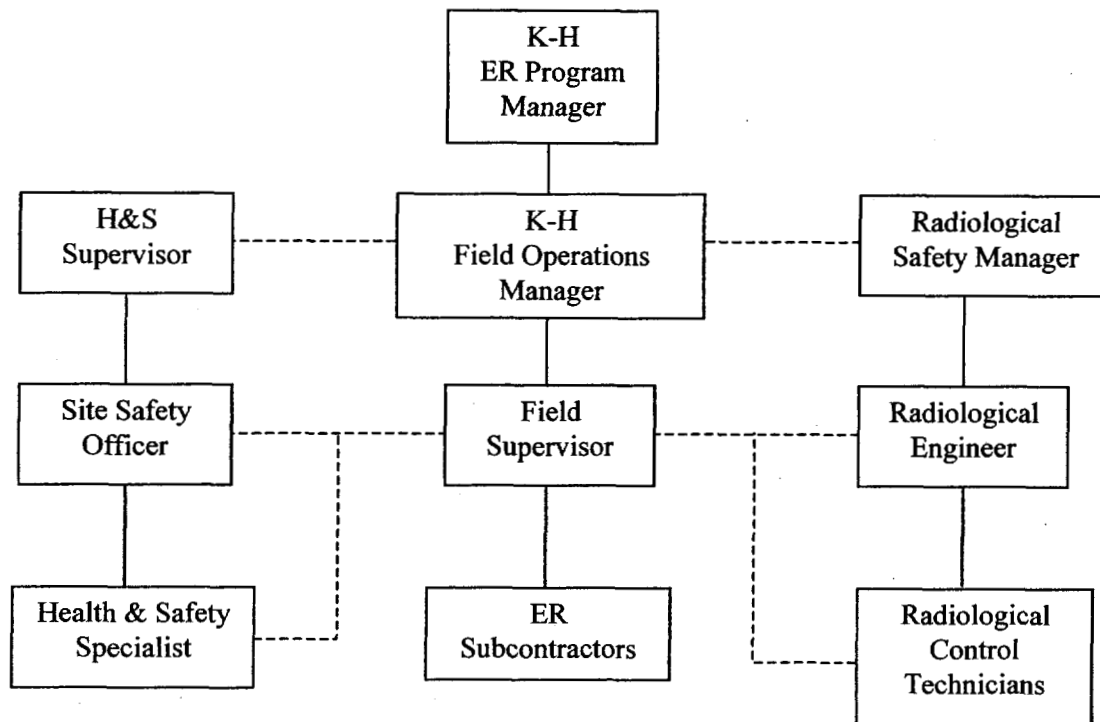
- attend site and project specific orientation, and follow the requirements set forth in this HASP and appropriate JHAs;
- provide SSO with copies of Material Safety Data Sheets (MSDS) for all hazardous chemicals brought on the site; and
- provide copies of all required training and medical authorizations to the SSO.

#### **4.12 On-Site Personnel And Visitors**

All personnel must read and acknowledge their understanding of this HASP, abide by the requirements of the plan, and cooperate with site supervision in ensuring a safe and healthful work site. Site personnel will immediately report any of the following to the Field Supervisor or SSO:

- Accidents and injuries, no matter how minor;
- Unexpected or uncontrolled release of chemical substances;
- Symptoms of chemical exposure;
- Unsafe or malfunctioning equipment; or
- Changes in site conditions that may affect the health and safety of project personnel

Figure 4.1 Project Organization



## 5.0 HAZARD ASSESSMENT

In accordance with DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*, OSHA safety regulations (29 CFR 1926) shall be followed during all phases of work on this Project. The following is a description of the safety concerns that are commonly encountered at the Site. This HASP does not describe all of the safety concerns that could apply for the ER Program. Development of a Project Specific HASP Addenda, and activity specific JHAs are intended to fill in the gaps and voids, not addressed in this HASP. The hazards associated with remediation activities at the RFETS include hazardous substances (chemical and radiological); biological hazards; and physical hazards.

### 5.1 Chemical Hazards

Table 5 summarizes the potential hazards associated with the three primary chemical contaminants at the site. Based upon site history many of the suspected chemicals of concern (COCs) have been identified in Table 5.1. Table 5.1 presents the physical and chemical characteristics for the COCs. The OSHA Permissible Exposure Limits (PELs) and the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) will be used as guidelines to evaluate potential exposure to the COCs. When present, the PELs and TLVs are the most recent published values. MSDSs for chemical products utilized at the Site may be obtained from the Chemical Dispensary (extension 7600). Neither Table



5, nor Table 5.1 are intended to address every potential chemical contaminant at the site, but is an attempt to address the most commonly occurring contaminants at the site.

The primary exposure pathway for many COCs is the inhalation of vapors or contaminated dust particles. However, other pathways such as ingestion, skin contact, and injection are also of concern with these products. Volatile chlorinated hydrocarbons are among some of the chemicals suspected at the site. These VOCs are typically in the vapor state at ambient temperatures ( $>40^{\circ}\text{F}$ ) and may pose an inhalation as well as dermal hazard during invasive soil activities.

In many cases, air monitoring will be conducted to locate, control, and reduce the potential for exposure (monitoring guidance is presented in Section 8.0). Dust suppression techniques such as water spraying and careful soil handling may be used to reduce potential exposures to contaminated airborne dust. The use of personal protective equipment will minimize the potential of inhalation and skin or eye contact with the COCs. Personnel may be exposed to accidental ingestion of contaminants by hand to mouth transfer after contact with contaminated materials. Ingestion of contaminants can be controlled on the site by specific prohibitions, work practices, and requirements for decontamination. Potential collocated worker exposures may be controlled by continuous perimeter air monitoring for VOCs and particulates, when necessary.

**Table 5 Hazards Associated with Site Contaminants**

Contaminant	Health Concern
Volatiles (VOCs)*	Acute exposure to VOCs can cause eye and skin irritations, headache, nausea, tremors, fatigue, numb and tingling limbs, nausea, and central nervous system depressant. Chronic effects include liver, kidney, eyes, central nervous system respiratory, cardiovascular, salivary, and liver damage. Excessive skin contact can cause defatting of the skin and subsequent dermatitis. Some VOCs are carcinogens.
Semi-volatiles*	Acute exposure to semi-volatiles can cause eyes, nose, throat and skin irritations, headache, nausea, dizziness, tremors, fatigue, chest pains, and skin burns. Chronic effects include kidney, eyes, central nervous system, respiratory, cardiovascular, salivary, and liver damage. Excessive skin contact can cause defatting of the skin and subsequent dermatitis. Some semi-volatiles are carcinogens.
Radiological	There are potential health hazards associated with exposure to radiological contaminants. Please refer to the ALARA Job Review and RWP for information related to these hazards and their mitigation.

\*These summaries were obtained from the NIOSH Pocket Guide to Chemical Hazards (June 1994) and the Documentation of the ACGIH TLVs (2000).

### **5.1.1 Volatile Organic Compounds (VOCs)**

Based on historical review, interviews with site personnel, and monitoring well data the typical VOCs of concern are suspected to be; carbon tetrachloride, methylene chloride, tetrachloroethene (PCE) and trichloroethene (TCE).

#### **5.1.1.1 Carbon Tetrachloride**

Carbon tetrachloride is a colorless, nonflammable liquid with a sweet aromatic odor. The odor threshold for carbon tetrachloride is between 140-580 parts per million (ppm). This odor threshold is well above the exposure limit requiring the use of supplied air respirators when exposures exceed the exposure guidelines. As with most of the chlorinated solvents burning of this product may release phosgene (choking, irritating gas) and hydrogen chloride.

Exposure to carbon tetrachloride is both a dermal and inhalation hazard. Carbon tetrachloride remove oils from the skin causing fissured dermatitis. Acute inhalation of carbon tetrachloride vapors effect the central nervous system, the liver, and the kidneys. Symptoms typical of acute inhalation exposure are: dizziness, nausea, and vomiting.

Chronic exposure leads to liver and kidney damage. Central nervous system damage can occur with high long-term exposure. Both acute and chronic effects are exacerbated in the presence of ingested alcohol. Carbon tetrachloride is an animal carcinogen and exposure should be kept to a minimum.

#### **5.1.1.2 Methylene Chloride**

Methylene chloride is a clear combustible liquid with a chloroform like odor. Methylene chloride has an odor threshold of 160 ppm, six and one-half times the OSHA PEL. The poor warning properties exhibited by this product require the use of supplied air respirators if exposure is expected to exceed the PEL.

Acute exposure to methylene chloride, like most solvents, produces central nervous system depression. The symptoms associated with acute methylene chloride exposure are: dizziness, staggering gait, blurred vision, and nausea. Liver and kidney damage may also occur in severe cases of overexposure. The body may take as long as two weeks to recover from severe methylene chloride exposures.

Chronic methylene chloride exposure may lead to liver, kidney, central nervous system, heart, and blood damage. Recent studies have indicated that workers exposed to high airborne concentrations of methylene chloride have increased levels of carboxyhemoglobin in the blood. Carboxyhemoglobin is the same product produced by exposure to carbon monoxide and interferes with oxygen transfer by the red blood cells. Many of the effects may have a latency period of several hours. Methylene chloride is a suspected carcinogen and exposure should be kept to a minimum.

#### **5.1.1.3 Trichloroethene**

TCE is a colorless, nonflammable, non-corrosive liquid with a sweet odor characteristic of chlorinated solvents. TCE is commonly used in machining operations as a cleaning solvent and degreasing agent. Inhalation of TCE vapors may cause irritation of the nose, eyes, and throat. Acute exposure to this product depresses the central nervous system exhibiting such symptoms as headache, dizziness, nausea, fatigue, blurred vision, and chemical intoxication. TCE is a suspected carcinogen, linked to liver tumor production in laboratory animals.

The odor threshold for TCE is reported to be 82 ppm, well above the TLV of 50 ppm. This poor warning property as well as the cancer potential require the use of supplied air respirators when exposures above the TLV are possible.

#### **5.1.1.4 Tetrachloroethene**

PCE, like TCE is a clear nonflammable liquid with a typical chlorinated solvent odor used as cleaners and degreasers. The odor threshold for this chemical is reported to be near 50 ppm, however, the odor may become inconspicuous after a short exposure. Therefore PCE is similar to TCE in that supplied air respiratory protection is required if exposures above the TLV are anticipated.

Acute exposure to PCE is manifested as central nervous system depression, liver damage, and anesthetic effects. Symptoms of exposure include dizziness, headache, and fatigue. Most of the symptoms subside with removal from the exposure.

Chronic exposures to PCE may cause liver, kidney, and central nervous system damage. PCE, like most chlorinated solvents, is a suspected carcinogen producing tumors in laboratory animals.

### **5.1.2 Metals**

A variety of metal contaminants have been utilized in various manufacturing processes at the site. The following metals are likely to be encountered during excavation activities, conducted as part of the ER Program:

- Uranium
- Beryllium
- Copper
- Cadmium
- Arsenic

Toxicologically these metals as a group have few similarities. Many of these metals, however, tend to accumulate in the kidneys and the bones. Additionally the hazard posed by heavy metals is that they typically have a long half-life in the body. The two primary routes of entry for metals is via inhalation or ingestion. The use of appropriate PPE, work practices, site control measures, and decontamination will protect the workers from exposure to metals encountered during excavation activities.

#### **5.1.2.1 Arsenic**

Arsenic is a steel-gray toxic heavy metal widely used in manufacturing industries. Arsenic compounds are typically separated into three classes: 1) inorganic arsenic compounds, 2) organic arsenic compounds, and 3) arsine gas. Arsine gas is by far the most toxic form of arsenic, followed by the trivalent and pentavalent forms, and least toxic being the elemental form of arsenic. Arsine gas is **not** a COC at the RFETS.

Inhalation of arsenic compounds is a common occupational route of exposure. Inhaled arsenic compounds are often deposited in the upper respiratory tract and cleared from the respiratory system by mucocilliary action, thus resulting in gastrointestinal absorption.

The acute effects of arsenic poisoning generally are seen following ingestion of inorganic arsenic compounds. The symptoms typical of acute poisoning via ingestion are: stomach pain, vomiting, and diarrhea. Acute inhalation of arsenic dust produces chest pain, cough, and headache.

Chronic arsenic exposure may lead to liver or kidney damage. OSHA has linked cancer of the skin, lungs, bone marrow, and lymph glands to chronic arsenic exposure. Symptoms of chronic arsenic exposure are:

weight loss, nausea, skin eruptions, hair loss, and peripheral neuritis. Horizontal white lines on the fingernails and toenails are common to chronic arsenic poisoning.

#### **5.1.2.2 Beryllium**

Beryllium is a lightweight and strong metal used widely in the nuclear, electronic, and machining industries. Beryllium can be alloyed with a variety of other metals.

Inhalation of beryllium dust is the most common exposure pathway for this metal. Some soluble beryllium salts are linked to skin sensitization and are considered primary irritants.

Eye damage as well as nasopharyngitis have also been reported from exposure to beryllium salts.

Beryllium and its compounds are considered highly toxic substances. Acute inhalation of beryllium containing dust typically manifests itself in a nonproductive cough, substernal pain, shortness of breath and weight loss. The degree and speed of onset of these symptoms is dependent upon the type and extent of the exposure. An intense exposure may result in severe pneumonitis leading to pulmonary edema.

Chronic exposure to beryllium dust is considered the primary hazard posed by this metal. The symptoms associated with chronic exposure are similar in nature to those exhibited in acute exposures. Workers with the chronic exposures to this metal may exhibit the following symptoms: respiratory effects (nonproductive cough and shortness of breath), weight loss, fatigue, and weakness. The latency period for onset of the berylliosis may be as long as ten years after the last exposure incident. Chronic beryllium disease manifests itself in a wide range of clinical variants from an asymptomatic nondisabling disease to a severely disabling disease reducing lung efficiency leading to heart failure.

#### **5.1.2.3 Cadmium**

Cadmium is a bluish-white metal commonly alloyed with other metals for a variety of uses, including as a neutron absorber in nuclear reactors. This metal is highly corrosion resistant and used as a protective coating for other metals.

Inhalation of cadmium dust or fume is the primary route of entry into the body. Cadmium is not readily absorbed by the gastrointestinal tract or the skin. Cadmium does, however, have a long half-life in the body, concentrating primarily in the liver and kidneys.

Acute toxicity to inhaled cadmium dust typically has a latency period of a few hours following the exposure incident. Symptoms appear progressively as generalized respiratory infection followed by coughing, chest pain, sweating, and chills. Within 24 hours following the exposure severe pulmonary irritation may develop accompanied by dyspnea, generalized weakness, and may lead to pulmonary edema.

Chronic cadmium poisoning effects the respiratory tract as well as lung function and may lead to a disabling form of emphysema. Other target organs effected by prolonged cadmium exposures are the liver and kidneys. OSHA considers cadmium as a potential kidney carcinogen.

#### **5.1.2.4 Copper**

Copper is a soft malleable metal reddish-brown in color. Copper is widely used in industry and is often alloyed with other metals such as tin, zinc, and beryllium. Copper metal typically forms a characteristic greenish oxide when exposed to an outside environment.

Copper is an essential element in humans with a low toxicity. Incidents of acute copper poisoning are rare and generally not serious. Accounts of copper poisoning typically are the result of ingestion of copper sulfate as a suicide attempt. Nausea, vomiting, diarrhea, and malaise are the symptoms associated with acute copper exposures. Some copper salts can act as irritants to the skin causing itching and dermatitis.

Chronic exposures to copper can result in perforation of the nasal septum and occurrences of metal fume fever. Metal fume fever is typified by flu-like symptoms dissipating 3-5 days after the exposure has been halted. Workers with Wilson's disease (hepatolenticular degeneration) are more susceptible to copper poisoning because of their abnormally high absorption, retention, and storage of copper in their bodies.

### **5.1.3 Other Chemical Hazards**

#### **5.1.3.1 Asbestos**

Asbestos is the name applied to a group of naturally occurring minerals that are mined from the earth. The six different types of regulated asbestos are:

- Amosite
- Chrysotile
- Tremolite
- Actinolite
- Anthophyllite

#### ***Crocidolite***

Of these six, three are used more commonly. Chrysotile is the most common, but it is not unusual to encounter Amosite, or Crocidolite as well. In many instances a single product will have a mixture of different asbestos types.

All types of asbestos can break into very tiny fibers. These individual fibers can be broken down so small that they can only be identified using an electron microscope.

Some individual fibers may be up to 700 times smaller than the diameter of a human hair. Because asbestos fibers are so small, once released into the air, they may stay suspended there for hours or even days.

Asbestos fibers are also virtually indestructible. They are resistant to chemicals and heat, and they are very stable in the environment. They do not evaporate into air or dissolve in water, and they are not broken down over time. Asbestos is probably the best insulator known to man. Because asbestos has so many useful properties, it has been used in over 3,000 different products.

Usually asbestos is mixed with other materials to form products. Floor tiles, for example, may contain only a small percentage of asbestos. Depending on what the product is, the amount of asbestos in asbestos-containing materials (ACM) may vary from less than 1% to 100%.

Asbestos may be found in many different products and many different places. Examples of products that might contain asbestos are:

- Sprayed on fire proofing and insulation in buildings
- Insulation for pipes and boilers
- Wall and ceiling insulation
- Ceiling tiles
- Floor tiles
- Putties, caulks, and cements (such as in chemical carrying cement pipes)
- Pipe insulation
- Roofing shingles
- Siding shingles on old residential buildings
- Wall and ceiling texture in older buildings and homes
- Joint compound in older buildings and homes
- Brake linings and clutch pads
- Flooring

The most common way for asbestos fibers to enter the body is through breathing. In fact, ACM is not generally considered to be harmful unless it is releasing dust or fibers into the air where they can be inhaled or ingested. Many of the fibers can become trapped in the mucous membranes of the nose and throat where they can then be removed, but some may pass deep into the lungs, or, if swallowed, into the digestive tract. Once they are trapped in the body, the fibers can cause health problems.

Asbestos is most hazardous when it is friable. The term "friable" means that the asbestos is easily crumbled by hand, releasing fibers into the air. Sprayed on asbestos insulation is highly friable. Asbestos floor tile generally is not.

Asbestos-containing ceiling tiles, floor tiles, undamaged laboratory cabinet tops, shingles, fire doors, siding shingles, etc. will not release asbestos fibers unless they are disturbed or damaged in some way. If an asbestos ceiling tile is drilled or broken, for example, it may release fibers into the air. If it is left alone and not disturbed, it generally will not.

Asbestos pipe and boiler insulation does not present a hazard unless the protective canvas covering is cut or damaged in such a way that the asbestos underneath is actually exposed to the air.

Damage and deterioration will increase the friability of asbestos-containing materials. Water damage, continual vibration, aging, and physical impact such as drilling, grinding, buffing, cutting, sawing, or striking can break the materials down making fiber release more likely.

In order to avoid being exposed to asbestos, one must be aware of the locations it is likely to be found. If it is not known whether something is asbestos or not, assume that it is until it is verified otherwise. If a material contains asbestos, it cannot be identified just by looking at it.

By knowing where asbestos is likely to be located and then taking measures not to disturb it, you will protect yourself and others from exposure to this hazardous substance

#### **5.1.3.2 Carbon Monoxide**

Carbon Monoxide is an odorless and colorless gas commonly generated during the combustion process of fossil fuels. Carbon monoxide is a chemical asphyxiate, interfering with the body's ability to exchange oxygen in blood. The carbon monoxide molecules rapidly pass from the lungs into the blood stream and attaches itself to the hemoglobin molecule in the blood stream. Hemoglobin has an affinity for carbon monoxide 250 times greater than for oxygen. This increased affinity the hemoglobin molecule has for carbon monoxide produces an added risk for continuous exposure scenarios.

Typical acute symptoms of carbon monoxide exposure are: headaches, dizziness, drowsiness, nausea, and unconsciousness. Death may occur if exposures are high, or if moderate to high exposures are experienced over extended periods of time.

Treatment for carbon monoxide poisoning involves removing the individual from the exposure area and possible treatment with oxygen to facilitate the removal of the carbon monoxide from the body. In severe cases of poisoning the individual may be treated in a hyperbaric chamber to speed-up the removal of the carbon monoxide from the blood stream.

#### **5.1.3.3 Cyanides**

Particulate cyanides are typified by sodium or potassium cyanide. Most particulate cyanides are white crystals at room temperature and stable in alkaline solutions. In acidic solutions, however, they release deadly hydrogen cyanide gas.

Cyanides in the particulate form are irritants to mucous membranes. All forms of cyanides act as chemical asphyxiates interfering with the body's oxidative process. Symptoms of acute cyanide exposure are: weakness, vomiting, respiratory collapse and death. Exposure to lower concentrations of cyanide produce headaches, nausea, vomiting, nasal bleeding, weakness, and confusion. Hydrogen cyanide is characterized by a bitter-almond odor near the TLV.



#### **5.1.3.4 Hydrogen**

Hydrogen is an odorless and colorless gas potentially generated when depleted uranium reacts slowly with water. Hydrogen gas is extremely flammable, with an explosive range between 4-74% in air.

The health hazard posed by hydrogen gas is asphyxiation. There are no PELs or TLVs established for hydrogen. However, at levels that become asphyxiating, the potential fire and explosion hazard become a greater concern.

#### **5.1.3.5 Oxides of Nitrogen**

Diesel exhaust emissions typically have nitrogen dioxide and nitric oxide as part of the exhaust gas stream. Both gases are in low concentrations in the exhaust stream.

Nitric oxide (NO) is a colorless odorless gas generated during the combustion of fossil fuels. Although present in diesel exhaust emissions, it is oxidized to nitrogen dioxide about thirty times more toxic. Nitrogen dioxide (NO<sub>2</sub>) is a reddish-brown irritating gas.

Both oxide forms of nitrogen are strong mucous membrane and pulmonary irritants. Typical symptoms associated with NO/NO<sub>2</sub> exposures are bronchial irritation; burning eyes, nose, and throat; and in severe cases delayed pulmonary edema.

#### **5.1.3.6 Sulfur Dioxide**

Sulfur dioxide is a colorless gas with irritating properties similar to those of nitrogen dioxide. Diesel exhaust is one example of a source of sulfur dioxide exposure.

Sulfur dioxide is a severe irritant, attacking the eyes, nose, throat, and lungs. Acute exposure may cause severe bronchial or lung damage. Chronic exposure results in watery eyes, burning in the nose and throat, and respiratory irritation. Some individuals may become acclimated to low level exposures over time.

Table 5.1 - Physical and Chemical Characteristics of Chemicals of Concern

Contaminant (Synonyms) (Abbreviations)	Action Level	OSHA PELS or ACGIH TLVs	OSHA IDLH	Physical/Chemical Characteristics	Routes of Exposure	First Aid	Exposure Symptoms
Arsenic (Inorganic compounds, as As) (Arsenia) CAS# 7440-38-2	0.005 mg/m <sup>3</sup>	PEL/TLV 0.01 mg/m <sup>3</sup> - TWA	Carcinogen 5.0 mg/m <sup>3</sup>	Metal. Silver-gray or tin white, brittle, odorless solid. Noncombustible solid in bulk form, but a slight explosion hazard in the form of dust when exposed to flame. MW: 74.9 Sp.Gr: 5.73 (Metal) BP: Sublimes VP: 0mm (Approximately) Sol: Insoluble MLT: 1135°F (Sublimes) Fl.P: NA UEL: NA IP: NA LEL: NA	Inhalation Ingestion Absorption Contact	Artificial respiration; Seek medical attention; Irrigate and wash area affected immediately.	Ulceration of nasal septum; dermatitis; peripheral neuropathy; gastrointestinal disturbance; respiratory irritation; hyperpigmentation of skin.
Beryllium (Beryllium compounds as Be) CAS# 7440-41-7	0.001 mg/m <sup>3</sup>	PEL 0.002 mg/m <sup>3</sup> TWA 0.005 mg/m <sup>3</sup> C (0.025 mg/m <sup>3</sup> - 30 min max peak)	Carcinogen 4.0 mg/m <sup>3</sup>	Metal. A hard, brittle, gray-white solid. Noncombustible solid in bulk form, but a slight explosion hazard in the form of dust when exposed to flame. MW: 9.0 Sp.Gr: 1.85 (Metal) BP: 4532°F VP: 0mm (Approximately) Sol: Insoluble MLT: 2349°F Fl.P: NA UEL: NA IP: NA LEL: NA	Inhalation Contact	Artificial respiration; Seek medical attention; Irrigate and wash area affected immediately.	Berylliosis (chronic exposure); anorexia, weight loss, weakness, chest pain, cough, clubbing of fingers, cyanosis, pulmonary insufficiency; eye irritation; dermatitis.
Cadmium dust (as Cd) CAS# 7440-43-9	0.0025 mg/m <sup>3</sup> (Total) 0.001 mg/m <sup>3</sup> (Resp)	PEL 0.005 mg/m <sup>3</sup> TWA (Total) 0.002 mg/m <sup>3</sup> TWA (Resp)	Carcinogen 9.0 mg/m <sup>3</sup>	Metal. Silver-white, blue-tinged, lustrous, odorless solid. Noncombustible in bulk form, but will burn in powder form. MW: 1212.4 Sp.Gr: 8.65 (Metal) BP: 1409°F VP: 0mm (Approximately) Sol: Insoluble MLT: 610°F Fl.P: NA UEL: NA IP: NA LEL: NA	Inhalation Ingestion	Artificial respiration; Seek medical attention; Irrigate and wash area affected immediately.	Pulmonary edema, difficulty breathing, cough, tight chest, substernal pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia, emphysema, proteinuria, mild anemia.
Carbon Monoxide CAS# 630-08-0	15 ppm	TLV 25 ppm-TWA	1500 ppm	Colorless, odorless gas MW: 28.0 Sp.Gr: NA BP: -313 °F VP: > 35 Atm Sol: 2% MLT: -337°F Fl.P: NA UEL: 74% IP: 14.01eV LEL: 12.5%	Inhalation	Fresh air; Seek medical attention	Headache, nausea, weakness, dizziness
Carbon Tetrachloride (Tetrachloromethane) CAS# 56-23-5	2.5 ppm Skin	5 ppm-TWA 10 ppm-STEL 25 ppm-C (200 ppm - 5 min max peak in any 4 hrs)	Carcinogen 200 ppm	Colorless liquid with a characteristic ether-like odor. Noncombustible liquid. MW: 153.8 Sp.Gr: 1.59 BP: 170°F VP: 91mm Sol: 0.05%FRZ: -9°F Fl.P: NA UEL: NA IP: 11.47eV LEL: NA	Inhalation Ingestion Absorption Contact	Artificial respiration; Seek medical attention; Irrigate and wash area affected immediately.	CNS depression; nausea and vomiting; liver and kidney damage; skin and eye irritation; drowsiness, dizziness, uncoordination.

Contaminant (Synonym) (Abbreviations)	Action Level	OSHA PELS or ACGIH TLVs	OSHA IDLH	Physical/Chemical Characteristics	Routes of Exposure	First Aid	Exposure Symptoms
Copper (dusts and mists) CAS# 7440-50-8	0.5 mg/m <sup>3</sup>	PEL 1.0 mg/m <sup>3</sup> TWA	100 mg/m <sup>3</sup>	Reddish, lustrous, malleable, odorless, solid. Noncombustible solid in bulk form, but powdered form may ignite. MW: 63.5 Sp.Gr: 8.94 BP: 4703°F VP: 0mm (Approximately) Sol: Insoluble MLT: 1981°F Fl.P: NA UEL: NA IP: NA LEL: NA	Inhalation Ingestion Contact	Artificial respiration; Seek medical attention; Irrigate and wash area affected immediately.	Irritates eyes, skin, and respiratory system; liver and kidney damage; increased risk of Wilson's disease.
Cyanide (as CN) (Sodium Cyanide) (Potassium Cyanide) CAS# 151-50-8	2.5 mg/m <sup>3</sup>	5.0 mg/m <sup>3</sup> TWA 5.0 mg/m <sup>3</sup> C	25 mg/m <sup>3</sup>	White, granular or crystalline solid with a faint, almond-like odor. Noncombustible solid, but contact with acids releases highly flammable hydrogen cyanide. MW: 49.0, 65.1 Sp.Gr: 1.60, 1.55 BP: 2725°F, 2957°F VP: 0mm (Approximately) Sol: 58%, 77%(77°F) MLT: 1047°F, 1173°F Fl.P: NA UEL: NA IP: NA LEL: NA OT 4.7 ppm	Inhalation Ingestion Absorption Contact	Artificial respiration; Seek medical attention; Irrigate and wash area affected immediately.	Irritates eyes, skin, and upper respiratory system; asphyxia; weakness, headache, confusion; nausea, vomiting; increased respiratory rate; slow grasping respiration, thyroid and blood changes
Hydrogen (Protinium) CAS# 1333-74-0	10%LEL	NA Simple Asphixiant	NA	Colorless, odorless, flammable gas. MW: 2.02 Sp.G: 0.070@BP BP: -423°F VP: Unknown Sol: 2%v/v (32°F) FRZ: -434.6°F Fl.P: NA UEL: 75% IP: 13.598 eV LEL: 4.0% OT: Odorless VD: 0.069	Inhalation Contact	Fresh air: Treat for possible frostbite.	
Hydrogen Cyanide (Formonitrile) (Hydrocyanic Acid) (Prussic Acid) CAS# 74-90-8	5 ppm	10 ppm-TWA 5 ppm-C [Skin]	50 ppm	Colorless or pale-blue liquid or gas (above 78°F) with a bitter almond-like odor. Class 1A flammable liquid. Flammable gas. MW: 27.0 Sp.Gr: 0.69 BP: 78°F VP: 630mm Sol: Miscible FRZ: 7°F Fl.P: 0°F UEL: 40% IP: 13.60eV LEL: 5.6% OT: 4.7 ppm VD: 0.94	Inhalation Ingestion Absorption Contact	Artificial respiration; Seek medical attention; Irrigate and wash area affected immediately.	Asphyxia; weakness, headache, confusion; nausea, vomiting; increased rate and depth of respiration or respiration slow and grasping; thyroid and blood changes.
Nitric oxide (Nitrogen Monoxide) CAS# 10102-43-9	13 ppm	TLV 25 ppm-TWA	100 ppm	Colorless, odorless gas MW: 30.0 Sp.Gr: NA BP: -241°F VP: > 34.2 Atm Sol: 5% MLT: -263°F Fl.P: NA UEL: NA IP: 9.271eV LEL: NA	Inhalation	Fresh air, seek medical attention	Eye, nose, throat, and respiratory irritation
Nitrogen Dioxide CAS# 10102-44-0	1.5 ppm	TLV 3 ppm-TWA 5 ppm-C	50 ppm	Reddish-brown, irritating gas MW: 30.0 Sp.Gr: NA BP: 70 °F VP: 720 mm Sol: Reacts MLT: 15 °F	Inhalation	Fresh air, seek medical attention	Eye, nose, throat, and respiratory irritation

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE  
*Environmental Restoration Program Health and Safety Plan  
for the Rocky Flats Environmental Technology Site*

Manual No: PRO-1468-HASP-01  
Revision No: DRAFT 0

Contaminant (Synonyms) (Abbreviations)	Action Level	OSHA PELS or ACGIH TLVs	OSHA IDLH	Physical/Chemical Characteristics	Routes of Exposure	First Aid	Exposure Symptoms
				FLP: NA UEL: NA IP: 9.75eVLEL: NA			
Sulfur Dioxide CAS# 7446-09-5	1 ppm	TLV 2 ppm-TWA 5 ppm-STEL	100 ppm	Colorless, irritating gas MW: 64.1 Sp.Gr: NA BP: 14 °F VP: 3.2 Atm Sol: 10 MLT: -104 °F FLP: NA UEL: NA IP: 12.3eVLEL: NA	Inhalation	Fresh air, Seek medical attention	Eye, nose, throat, and respiratory irritation
Tetrachloroethylene (Perchloroethylene) (Tetrachloroethene) (Perk) (PCE) CAS# 127-18-4	12 ppm	25 ppm-TWA 100ppm- STEL 200 ppm-C (300 ppm - 5 min max peak in any 3 hrs)	Carcinogen 150 ppm	Colorless liquid with a mild chloroform-like odor. Noncombustible liquid. MW: 165.8 Sp.Gr: 1.62 BP: 250°F VP: 14mm Sol: 0.02%FRZ: -2°F FLP: NA UEL: NA IP: 9.32eVLEL: NA OT: 47 ppm VD: 5.7	Inhalation Ingestion AbsorptionC ontact	Artificial respiration; Seek medical attention; Irrigate and wash area affected immediately.	Eye, nose, throat irritation; nausea; flush face and neck; vertigo, dizziness, incoordination, headache, sleepiness; skin erythema; liver damage.
Trichloroethylene (Ethylene Trichloride) (Trichloroethene) (TCE) CAS# 79-01-6	25 ppm	50 ppm-TWA 100ppm- STEL 200 ppm-C (300 ppm - 5 min max peak in any 2 hrs)	Carcinogen 1,000 ppm	Colorless liquid with a chloroform-like odor. Combustible liquid. MW: 131.4 Sp.Gr: 1.46 BP: 189°F VP: 58mm Sol: 0.0001% FRZ: -99°F FLP: 295°F UEL: 10.5% IP: 9.45eVLEL: 8% OT: 82 ppm VD: 4.53	Inhalation Ingestion AbsorptionC ontact	Artificial respiration; Seek medical attention; Irrigate and wash area affected immediately.	Headache, vertigo; visual disturbance, fatigue, giddiness, tremor, sleepiness, vomiting, nausea; dermatitis, cardiac arrhythmias, paresthesia; eye and skin irritation; liver damage

**Table 5.1 (Continued)**  
**Physical and Chemical Characteristics of Chemicals of Concern**

**Key:**

- ACGIH - American Conference of Governmental Industrial Hygienists
- BP - Boiling point
- C - Ceiling-Concentration shall not be exceeded at any time
- CNS - Central nervous system
- Fl. pt. - Flash point-the temperature at which the liquid phase gives off enough vapor to flash when exposed to an external ignition source. Closed cup, unless otherwise noted
- FRZ - Freezing point for liquids and gases, °F
- IDLH - Immediately Dangerous to Life and Health-Maximum concentration from which one could escape within 30 minutes without experiencing any irreversible health effects
- IP - Ionization potential, eV (electron volts)
- LEL - Lower explosive (flammable) limit in air, % by volume
- mg/m<sup>3</sup> - milligrams per cubic meter
- MW - Molecular weight
- NA - Not applicable
- ND - Not Determined
- OSHA - Occupational Safety and Health Administration
- OT - Odor Threshold
- PEL - Permissible Exposure Limit-Concentration is a time weighted average (TWA) that must not be exceeded during any 8-hour workshift of a 40-hour workweek. (OSHA)
- PPM - Parts per million
- Skin - Potential significant contribution to the overall exposure by the cutaneous route, including mucous membranes and the eyes, either by contact with vapors or, of probable greater significance, by direct skin contact with the substance.
- Sol - Solubility in water at 68°F, % by weight.
- Sp.Gr - Specific gravity at 68°F referenced to water at 39.2°F
- STEL - Short Term Exposure Limit-A 15-minute average concentration which should not be exceeded at any time during a workday. Exposure over the PEL or TLV up to the STEL should be no longer than 15 minutes and should not occur more than four times per day. There should be at least 60 minutes between successive exposures in this range.
- Sublimes - A process in which a material passes directly from a solid into a gaseous state and condenses to form solid crystals, without liquifying.
- TLV - Threshold Limit Value-Concentration that nearly all workers may be repeatedly exposed, day after day, without adverse effect. (Based on an 8-hour workday and 40-hour workweek). (ACGIH)
- UEL - Upper explosive (flammable) limit in air, % by volume
- VD - Vapor Density
- VP - Vapor pressure at 68°F in millimeters (mm) mercury (Hg) unless otherwise noted.

**References:**

- Air Contaminants- Permissible Exposure Limits (29 CFR 1910.1000).
- American Conference of Governmental Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices for 1995 to 1996.
- National Institute of Occupational Safety and Health, Pocket Guide to Chemical Hazards, June, 1994.

## 5.2 Radiological Hazards

Based on analytical sample results, the historical record, and interviews with workers, americium-241, plutonium-239/240, uranium-233/234, uranium-235, and uranium-238 are commonly encountered during

Remediation activities at the Site. The physical and chemical characteristics of the radionuclides are presented in Table 5.2.

Radiological hazards, including potential co-located worker exposure, associated with remediation activities will be controlled by the implementation of a rigorous radiological control program which includes the following aspects:

- strict adherence to RWPs;
- strict adherence to the ALARA review;
- use of high volume and low volume radiological air monitors (when required);
- the operation of CAMs (when required);
- contamination control surveys;
- radiation surveys;
- personnel frisking for radiological contamination; and
- aggressive dust suppression.

The radiological hazards can be broken down into two distinct categories: external radiation exposure, and internal radiation exposure.

### **5.2.1 External Radiation Exposure**

Beta and gamma radiations are emitted by radionuclides at the site. Beta radiation travels a relatively short distance and cannot penetrate beyond the shallow layers of the skin or the lens of the eye, and so associated hazards are confined to these areas when in close proximity to the source. Eye and skin exposure to external beta radiation is greatly reduced or eliminated through the use of eye protection, personal protective clothing, and work practices such as remote handling.

External gamma radiation, unlike beta radiation, readily penetrates deep into the body and is therefore hazardous to internal organs. Clothing and eye protection are not effective at reducing external gamma radiation exposure. Four accepted methods to minimize gamma exposures are:

- the use of shielding between personnel and the radiation source;
- minimizing time in the radiation area;
- maximizing distance from the radiation source; and
- reducing or minimizing the source of radiation.

Should external radiation be of concern, the most effective methods of reducing worker exposure to external gamma radiation will be by posting areas where elevated gamma exposure rates exist and limiting the amount of time workers spend in these areas. Work assignments will be evaluated to ensure that personnel are maintaining a maximum possible distance from gamma radiation sources.

Potential external radiation exposures will be tracked through the use of whole body dosimeters. Wrist dosimeters may be worn as determined by Radiological Engineering.

### **5.2.2 Internal Radiation Exposure**

Alpha and beta radiation is a significant hazard when deposited in internal organs. Alpha and beta radiation is principally admitted to the body by inhalation of airborne contamination but ingestion, injection, and absorption of surface contamination through the skin are also possible. Radioactive contamination existing in the form of loose material is capable of migrating or being transported by a variety of mechanisms such as movement of personnel, vehicles, equipment, and wind.

Air particulates that are suspended or have settled out on horizontal surfaces (equipment) and have been re-suspended pose an inhalation hazard. Drinking contaminated water, eating contaminated food, and/or transferring contamination to the mouth pose an ingestion hazard. Abrasions, lacerations, or punctures of the skin resulting from contact with contaminated surfaces pose an injection hazard. Absorption hazards exist when radioactive isotopes are chemically incorporated in a substance that is able to permeate the skin.

Exposure to radioactive contamination and the potential for internal contamination will be controlled by the proper use and removal of PPE; administrative controls including prohibitions against smoking, eating, drinking and chewing; and proper use of respirators when airborne contamination above prescribed limits is suspected.

Potential internal radiation exposures will be tracked through the use of project specific bioassays.

### **5.2.3 Uranium**

Uranium is a hard silvery-white amphoteric radioactive metal found in three naturally occurring isotopic forms:  $U^{234}$ ,  $U^{235}$ , and  $U^{238}$ . Depleted uranium (DU) is uranium that contains less of the isotope  $U^{235}$  than the naturally occurring fraction. DU, a radioactive metal, is potentially pyrophoric. The radioactive characteristic of the metal does not affect its potential to be pyrophoric. DU's radioactivity hazard is considered to be low, while its toxicity hazard is considered high.

Most metallic uranium is machined in large blocks and does not present a significant fire risk, unless exposed to a severe and prolonged external heat source. Once large blocks of uranium metal are ignited they tend to burn slowly and without a visible flame. Burning uranium does, however, react violently with halogenated hydrocarbons.

Finely divided uranium metal, such as from machining operations (chips and turnings), are subject to spontaneous ignition when exposed to air. Once ignited, the finely divided uranium may appear as a bright yellow-red ember and quickly reach a white-hot state.

Many metals, including uranium, form protective oxide layers over the metal surface during the initial stages of oxidation. This coating of oxide greatly reduces the metals ability to ignite spontaneously. Once uranium is completely oxidized it is no longer pyrophoric. Therefore, finer-grained material will completely oxidize more quickly than more massive blocks of material.

Under moist conditions uranium reacts slowly with the available water to form uranium oxide and hydrogen gas. Uranium metal stored under moist conditions tends to react more slowly and the fire hazard is reduced. Uranium forms three common oxides, uranium dioxide ( $\text{UO}_2$ ) a brown to black powder that is relatively insoluble in body fluids, presenting a lung hazard primarily. Uranium trioxide is a brownish-yellow to red powder. This oxide form is slightly more transportable in body fluids posing a greater kidney hazard than the other oxide forms of uranium. If uranium turnings are heated to near 400°F or allowed to react with moist air for long periods of time,  $\text{U}_3\text{O}_8$  is formed. This black powder is the most chemically stable of the uranium oxides.  $\text{U}_3\text{O}_8$  is not soluble in body fluids making it primarily a lung hazard to exposed workers.

Uranium and its compounds are highly toxic, with the soluble forms presenting the greatest toxicological hazard. The biologic hazard presented by uranium exposure may manifest itself as chemical toxicity, a radiological hazard, or both. The inhalation of particulate uranium or its compounds present the most likely occupational exposure pathway. Uptake can occur by ingestion, however, absorption in the gastrointestinal track is low. The biological half-life of uranium oxide is typically reported to be 15 days.

Acute uranium poisoning produces damage primarily in the kidneys. Uranium absorbed by the lungs is transferred to the blood producing damage to the kidney tubules and subsequently halting kidney functions.

The chronic effects of uranium exposure are hard to separate from the radiological hazard posed by long term exposures. As would be expected, chronic exposure to soluble uranium compounds contribute to kidney damage. Chronic exposure to insoluble forms of uranium result in a radiological risk to the lungs.

#### **5.2.4 Americium**

Americium is man-made radioactive metal, a few grams of which are produced from plutonium in nuclear reactors each year. Glenn Seaborg, Ralph James, L. Morgan, and Albert Ghiorso discovered americium during the Manhattan project in 1944. Americium was a by-product of the testing with the atomic bomb.

Americium was actually discovered along side element number 96 (Curium). In fact, they were discovered in reverse order. Unlike curium, americium was created by bombarding plutonium with neutrons. In doing that they first discovered the americium isotope 241. The key to the success in discovering such new elements as these was the knowledge that they would have similar properties to the heavier rare earth metals.

Upon its discovery americium was named thus because it had many similarities to the rare-earth metal, europium. Since europium was named after the continent of Europe (place of discovery) the same was done for americium.

The isotope  $\text{Am}_{241}$  can be prepared in relatively pure form by extraction as a decay product over a period of years from strongly neutron- bombarded plutonium. The luster of freshly prepared americium metal is white and more silvery than plutonium or neptunium prepared in the same manner. Americium is a malleable, radioactive metallic element, similar to lead. It appears to be more malleable than uranium or neptunium and tarnishes slowly in dry air at room temperature. Americium is thought to exist in two forms: an alpha form which has a double hexagonal close-packed structure and a loose-packed cubic beta form.

Americium has 16 known isotopes, all of which are radioactive. Americium-243, the most stable isotope, has a half-life of over 7,300 years. Americium-241, which has a half-life of about 430 years, is more often used in



chemical investigations, since it is easily prepared in a fairly pure form. Americium is used as a portable source for gamma radiography, for crystal research, and as target material in nuclear reactors or particle accelerators for the production of even heavier synthetic elements. The flat glass industry has used americium as a radioactive glass thickness gauge. Americium is also used in household smoke detectors.

### 5.2.5 Plutonium

Plutonium belongs to the class of elements called transuranic elements whose atomic number is higher than 92, the atomic number of uranium. Essentially all transuranic materials in existence are manmade. The atomic number of plutonium is 94.

Plutonium has 15 isotopes with mass numbers ranging from 232 to 246. Isotopes of the same element have the same number of protons in their nuclei but differ by the number of neutrons. Since the chemical characteristics of an element are governed by the number of protons in the nucleus, which equals the number of electrons when the atom is electrically neutral (the usual elemental form at room temperature), all isotopes have nearly the same chemical characteristics. This means that in most cases it is very difficult to separate isotopes from each other by chemical techniques.

The physical properties of plutonium metal are summarized in Table 5.2 below.

**Table 5.2**  
**Physical Characteristics of Plutonium Metal**

Color:	silver
Melting point:	641 deg. C
Boiling point:	3232 deg. C
Density:	16 to 20 grams/cubic centimeter

All isotopes of plutonium are radioactive, but they have widely varying half-lives. The half-life is the time it takes for half the atoms of an element to decay. For instance, plutonium-239 has a half-life of 24,110 years while plutonium-241 has a half-life of 14.4 years. The various isotopes also have different principal decay modes. The isotopes present in commercial or military plutonium-239 are plutonium-240, -241, and -242. Table 5.3 below shows a summary of the radiological properties of five plutonium isotopes.

The isotopes of plutonium that are relevant to the nuclear and commercial industries decay by the emission of alpha particles, beta particles, or spontaneous fission. Gamma radiation, which is penetrating electromagnetic radiation, is often associated with alpha and beta decays.

**Table 5.3**  
**Radiological Properties of Important Plutonium Isotopes**

	Pu-238	Pu-239	Pu-240	Pu-241	Pu-242
Half-life(in years)	87.74	24,110	6537	14.4	376,000
Specific activity(curies/gram)	17.3	.063	.23	104	.004
Principal decay mode	alpha	alpha	alpha some spontaneous fission(a)	beta	alpha
Decay energy(MeV)	5.593	5.244	5.255	.021	4.983
Radiological hazards	alpha, weak gamma	alpha, weak gamma	alpha, weak gamma	beta, weak gamma(b)	alpha, weak gamma

Source: CRC Handbook of Chemistry and Physics; 1990-1991. Various sources give slightly different figures for half-lives and energies.

- a) Source of neutrons causing added radiation dose to workers in nuclear facilities. A little spontaneous fission occurs in most plutonium isotopes.  
 b) Plutonium-241 decays into Americium-241, which is an intense gamma-emitter.

Table 5.4 describes the chemical properties of plutonium in air. The oxidation of plutonium represents a health hazard since the resulting stable compound, plutonium dioxide is in particulate form that can be easily inhaled. It tends to stay in the lungs for long periods, and is also transported to other parts of the body. Ingestion of plutonium is considerably less dangerous since very little is absorbed while the rest passes through the digestive system. In pure form plutonium is a hard and brittle metal, like cast iron, but spontaneously ignites in air to form PuO<sub>2</sub>.

**Table 5.4 How Plutonium Metal Reacts in Air**

Forms and Ambient Conditions:	Reaction:
Non-divided metal at room temperature (corrodes)	relatively inert, slowly oxidizes
Divided metal at room temperature (PuO <sub>2</sub> )	readily reacts to form plutonium dioxide
Finely divided particles under about 1 millimeter diameter particles over about 1 millimeter diameter	spontaneously ignites at about 150° C(c) spontaneously ignites at about 500° C.
Humid, elevated temperatures (PuO <sub>2</sub> )	readily reacts to form plutonium dioxide

- c) US DOE, "Assessment of Plutonium Storage Safety Issues at DOE Facilities,"  
 DOE/DP-0123T (Washington, DC: US DOE, Jan. 1994).

The risks posed to workers and communities by stored plutonium depend upon the route of exposure as well as the particle size, isotope, and chemical form.

Weapons-grade plutonium outside the body presents little risk unless exposures are frequent and extensive. It emits primarily alpha particles, which cannot penetrate skin, clothing, or even paper. Nearly all the energy from plutonium is deposited on the outer, nonliving layer of the skin, where it causes no damage. The

neutrons and the relatively weak gamma photons it emits can penetrate the body, but large amounts of weapons-grade plutonium would be needed to yield substantial doses.

Workers wearing only lead aprons can handle steel drums containing solid plutonium metal with no immediate untoward effects. However, as weapons-grade plutonium ages, it becomes more dangerous because some of the contaminating plutonium-241 is converted via beta decay to americium-241, which emits far stronger gamma radiation.

On the other hand, plutonium inside the body is highly toxic. Solid plutonium metal is neither easily dispersed nor easily inhaled or absorbed into the body. But if plutonium metal is exposed to air to any degree, it slowly oxidizes to plutonium oxide ( $\text{PuO}_2$ ), which is a powdery, much more dispersable substance. Depending on the particle size, plutonium-239 oxide may lodge deep in the alveoli of the lung where it has a biological half-life of 500 days, and alpha particles from the oxide can cause cancer. Also, fractions of the inhaled plutonium oxide can slowly dissolve, enter the bloodstream, and end up primarily in bone or liver.

Plutonium oxide is weakly soluble in water. If it is ingested in food or water, only a small fraction (4 parts per 10,000) is absorbed into the gastrointestinal tract. However, it may take just a few millionths of a gram to cause cancer over time. In animals, small doses induce cancer, especially in lung and bone.

In published studies of plutonium's effects on humans, most subjects were exposed to multiple sources of radiation. Some researchers say the available health data on plutonium workers have not yet been used to do careful epidemiological studies, because researchers have been denied access to much of the data on workers and military personnel exposed to plutonium. In the studies done so far, plutonium workers do not show major excesses of any type of cancer.

Because of the relative lack of human data, the risks of chronic exposure to plutonium are uncertain. Exposure standards in the U.S. are based partly on studies of survivors of Hiroshima and Nagasaki and partly on animal experiments.

Despite being toxic both chemically and because of its ionizing radiation, plutonium is far from being "the most toxic substance on earth" or so hazardous that "a speck can kill". On both counts there are substances in daily use that, per unit of mass, have equal or greater chemical toxicity (arsenic, cyanide, caffeine) and radiotoxicity (smoke detectors).

There are three principal routes by which plutonium can reach human beings:

- ingestion,
- contamination of open wounds,
- inhalation.

Ingestion is not a significant hazard, because plutonium passing through the gastrointestinal tract is poorly absorbed and is expelled from the body before it can do harm.

Contamination of wounds has rarely occurred although thousands of people have worked with plutonium. Their health has been protected by the use of remote handling, protective clothing and extensive health monitoring procedures.

The main threat to humans comes from inhalation. While it is very difficult to create airborne dispersion of a heavy metal like plutonium, certain forms, including the insoluble plutonium oxide, at a particle size less than 10 microns, are a hazard. If inhaled, much of the material is immediately exhaled or is expelled by mucous flow from the bronchial system into the gastrointestinal tract, as with any particulate matter. Some however will be trapped and readily transferred, first to the blood or lymph system and later to other parts of the body, notably the liver and bones. It is here that the deposited plutonium's alpha radiation may eventually cause cancer.

However, the hazard from Pu-239 is similar to that from any other alpha-emitting radionuclides that might be inhaled. It is less hazardous than those which are short-lived and hence more radioactive, such as radon daughters, the decay products of radon gas, which (albeit in low concentrations) are naturally common and widespread in the environment.

Plutonium is one among many toxic materials that have to be handled with great care to minimize the associated but well understood risks.

**Table 5.5 Physical and Chemical Characteristics of Radionuclides of Concern**

Contaminant (Synonyms) (Abbreviations)	DOE or Site Administrative Limits	OSHA IDELH <sup>1</sup>	Physical/Chemical Characteristics	Routes of Exposure	First Aid	Exposure Symptoms
Americium 241 (Am-241)	5 rem/yr $2 \times 10^{-12}$ uCi/ml DAC <sup>2</sup>	Carcinogen	Silvery, somewhat malleable radioactive metal.	Inhalation Ingestion Absorption Contact	Follow directions of on-site Radiological Personnel.	No acute symptoms from low level exposures
Plutonium 239/240	5 rem/yr $2 \times 10^{-12}$ uCi/ml DAC	Carcinogen	Silvery, radioactive metal	Inhalation Ingestion Absorption Contact	Follow directions of on-site Radiological Personnel.	No acute symptoms from low level exposures
Uranium 233/234	5 rem/yr $2 \times 10^{-11}$ uCi/ml DAC 0.05 mg/m <sup>3</sup> -TWA 0.06 mg/m <sup>3</sup> -C	Carcinogen 10 mg/m <sup>3</sup>	Silvery, radioactive metal	Inhalation Ingestion Absorption Contact	Follow directions of on-site Radiological Personnel.	No acute symptoms from low level exposures
Uranium 235	5 rem/yr $2 \times 10^{-11}$ uCi/ml DAC 0.05 mg/m <sup>3</sup> -TWA 0.06 mg/m <sup>3</sup> -C	Carcinogen 10 mg/m <sup>3</sup>	Silvery, radioactive metal	Inhalation Ingestion Absorption Contact	Follow directions of on-site Radiological Personnel.	No acute symptoms from low level exposures
Uranium 238	5 rem/yr $2 \times 10^{-11}$ uCi/ml DAC 0.05 mg/m <sup>3</sup> -TWA 0.06 mg/m <sup>3</sup> -C	Carcinogen 10 mg/m <sup>3</sup>	Silvery, radioactive metal	Inhalation Ingestion Absorption Contact	Follow directions of on-site Radiological Personnel.	No acute symptoms from low level exposures
<sup>1</sup> mg/m <sup>3</sup> are for chemical properties <sup>2</sup> DAC - Derived Air Concentration						

### **5.3 Biological Hazards**

During field work at the Site, personnel may encounter a wide variety of biological hazards such as insects, spiders, reptiles, and mammals. Biological hazards may act as infectious, allergenic, or toxic agents to the workers.

#### **5.3.1 Insects**

The most common insects of concern at the RFETS area are: bees, wasps and hornets. Stings of these insects may cause serious allergic reactions in certain individuals. Personnel with known insect allergies or sensitivities should notify the SSO before field work begins. If a person is stung by a bee, wasp, or hornet, resulting in a medical emergency, call extension 2911, notify the SSO or Field Supervisor, and immediately transport the person to the RFETS medical center.

#### **5.3.2 Arachnids**

Ticks and spiders are the two most common types of arachnid hazards encountered at the RFETS site. Ticks are parasites that feed on the blood of an animal/human host and can carry several severe diseases, the least severe bringing several days of fever and pain and the worst causing brain damage. Ticks are picked up on clothing in grassy areas of the site. Preventive measures include careful inspection of clothing and body parts at the end of each day. In the event that someone is bitten by a tick it should be reported to the SSO or Field Supervisor for medical assistance if required.

Poisonous spiders are also a potential biohazard for field personnel. Black widow spiders are nocturnal hunters and consequently may be present under rocks or other ground debris during daylight hours. Care should be taken when moving or rummaging in such areas and the use of gloves is required. If site personnel encounter a black widow and are bitten call extension 2911, notify the SSO or Field Supervisor, and immediately transport the person to the RFETS medical center.

#### **5.3.3 Snakes**

Poisonous snakes may also be encountered at the site. Site workers should exercise caution for the presence of rattlesnake at the site. Personnel should visually check before reaching into a covered area and walking through grassy areas. If a person is bitten by, call extension 2911, notify the SSO or Field Supervisor, and immediately transport the person to the RFETS medical center.

#### **5.3.4 Mammals**

Rodents, coyotes and foxes are some of the mammals indigenous to the RFETS. They are typically fearful of humans and will try to escape if encountered. These animals may become aggressive when defending their young, their dens, or when they are sick or injured. Personnel should avoid contact with any of these animals and contact Marsha Murdock at Ext. 3560 for disposition. If bitten by an animal exhibiting uncharacteristic behavior, there is the possibility that the animal has rabies. If the animal can be captured or contained *safely*, it can be tested for the presence of rabies. If a person is bitten, call extension 2911, notify the SSO or Field Supervisor, and immediately transport the person to the RFETS medical center.

### **5.3.5 Poisonous Plants**

The most common poisonous plant in this area is poison ivy. Allergic contact dermatitis due to contact with the plant leaves or stems is the most common response reported by field personnel. Contact with this plant should be avoided. In the event that the contact with the plant is unavoidable, protective gloves and clothing shall be worn.

### **5.3.6 Bloodborne Pathogens**

Employees will be protected from the potential hazards of bloodborne pathogens through the use of universal precautions, and PPE.

It is anticipated that bloodborne pathogens could only be expected in an emergency situation (severe personnel injury). The following precautions should be followed whenever possible. It is understood that in rare and extraordinary circumstances, it may be the employee's professional judgment that in the given situation the use of the following precautions (including PPE) would prevent the proper delivery of health care or pose an increased hazard to the personal safety of the worker or co-worker.

#### Universal Precautions

Universal Precautions applies to blood, or any bodily fluid that may contain blood, whether or not blood is visible. Although the amount of blood or body fluids required to constitute an infectious risk has been defined by OSHA, EPA and others as "substantial," "dripping" and "15 milliliters", this HASP requires that workers protect themselves from all potentially infective fluids, even of hardly visible quantity.

Universal precautions will be observed in order to prevent contact with blood or other potentially infectious materials. All blood or other potentially infectious material will be considered infectious regardless of the perceived status of the source individual.

#### Personal Protective Equipment

PPE should be used to minimize exposure, when practical. Gloves are the primary element of PPE. Safety glasses and/or goggles are also appropriate. Any garments which are penetrated by blood or other bodily fluids shall be removed immediately or as soon as feasible. All PPE should be removed prior to leaving the work area.

### **5.4 Physical Hazards**

The following sections discuss physical hazards and the measures to be taken to control the hazards.

#### **5.4.1 Heavy Equipment Hazards**

The operation of heavy equipment poses a hazard to personnel, equipment, and property. Control measures for the safe operation of heavy equipment will include:

- heavy equipment from off site vendors will be inspected by K-H Health and Safety;
- hoisting equipment from off site vendors will be inspected by K-H Health and Safety;

- back-up alarms;
- on-board fire extinguisher;
- heavy equipment will have rollover protection systems;
- operators will be properly trained in the use and limitations of the specific pieces of heavy equipment being operated;
- heavy equipment will be inspected by the operator prior to the beginning of each shift and an inspection checklist will be completed;
- seat belts will be worn by heavy equipment operators at all times;
- establishing heavy equipment roadways and operating areas;
- ground personnel will wear orange reflective vests and hard hats when heavy equipment is in use;
- personnel will stay away from all heavy equipment while they are in operation and maintain line of site with the operator;
- when sampling or obtaining readings at the excavator or front end loader buckets, the operator will set the bucket on the ground, disengage the hydraulic system, set the parking brake, and give a hand signal indicating that ground personnel may approach;
- at no time will any personnel position themselves under hydraulically operated equipment or loads; and
- the backing up of all heavy equipment will require a spotter to ensure that the path of travel is clear.

#### **5.4.2 Excavation Hazards**

Excavations pose a hazard due to cave-ins, slips, trips, falls, and underground utilities. Measures used to control these hazards include:

- the preparation and approval of Soil Disturbance Permits which address overhead and underground utility hazards;
- excavations will be inspected by a competent person prior to each shift, during each shift, and immediately after any rain or snow storms or other hazard increasing occurrences;
- heavy equipment entry into excavations will not be permitted unless the excavation is properly sloped and entry approval has been obtained from a Kaiser-Hill Excavation Specialist;
- heavy equipment will be operated in accordance with the manufacturers recommendations in regards to safe operating distances from an excavation;
- at no time will the counterweight on the excavator be positioned above the open excavation;
- a spotter will be present during all excavation activities;
- personnel entry into excavations will not be permitted unless the excavation is properly sloped and entry approval has been obtained from a Kaiser-Hill Excavation Specialist;



- personnel will stay a minimum of six feet away from the edge of an excavation when it is not sloped at 1.5:1;
- personnel closer than six feet to the excavation must wear a full body harness and lifeline attached to an approved anchorage point; and
- equipment, except the excavator, will be kept a minimum of two feet away from the edge of an excavation when it is not sloped at 1.5:1.

### **5.4.3 Aerial Manlift Hazards**

The operation of aerial lifts, such as scissor lifts and boom lifts, poses a hazard to personnel, equipment, and property. Control measures for the safe operation of aerial lifts will include:

- Aerial Lifts from off site vendors will be inspected by Health and Safety prior to use;
- Only trained and authorized personnel will be allowed to operate the aerial work platform;
- Operators will be properly trained in the use and limitations of the specific pieces of aerial lift equipment being operated;
- Aerial lift equipment will be inspected by the operator prior to the beginning of each shift and an inspection checklist will be completed;
- Prior to and during operations the site must be checked for hazards such as ditches, drop-offs or holes, bumps, obstruction, debris, overhead obstructions and high voltage conductors, and other possible hazardous conditions;
- Before elevating the work platform the operator must: check for overhead hazards; make sure platform is only elevated on a firm and level surface; make sure of proper load distribution on the platform; make sure platform guardrails are properly installed and gates are closed; and check to see that all occupants have the proper fall protection on and properly attached;
- Before and during driving while elevated, the operator must: keep a clear view of the path of travel; maintain distance from obstacles, debris and other hazards in the path; and maintain a safe distance from overhead obstacles (a minimum of 10 feet from power lines);
- Personnel shall maintain a firm footing on the platform and where required, personnel must ONLY attach full body harness and shock absorbing lanyard (or retractable lifeline system with a locking snap hooks) devices to manufacturer approved attachment points;
- Care shall be taken to prevent ropes, or electrical cords from becoming entangled in the work platform when it is being elevated or lowered; and
- Operator shall ensure that the area surrounding the platform is clear of personnel and equipment before lowering.

Operator shall immediately report to Site Supervisor or HSS any defects or malfunctions that become evident during operation.

#### **5.4.4 Noise Exposure Hazards**

Work at the site may expose personnel to high noise levels from the operation of heavy equipment and hand tools. Excessive noise exposure can cause both temporary and permanent effects on hearing. The temporary effects of excessive noise include ringing in the ears, interference with communication, and hearing threshold changes. The effect of long-term excessive noise includes varying degrees of noise-induced hearing loss. Measures used to control noise exposure hazards will include:

- noise monitoring to determine employee exposure;
- hearing protection for exposures of greater than 85 decibels (dBA) for any length of time;
- noise monitoring to confirm the effectiveness of the hearing protection worn; and
- noise dosimetry to determine employee exposure and whether participation in the Hearing Conservation Program is required. The Hearing Conservation Program includes both training and audiometric testing.

A Sound Level Meter (SLM) may be used on site to identify noise hazard contours during implementation of a project. Based on the use of the SLM, the area will be cordoned off and noise hazard warning signs shall be placed within the containment area. Personal protection (earplugs and/or ear muffs) against the effects of noise shall be provided whenever personnel noise exposures equal or exceed a sound level of 85 dBA.

#### **5.4.5 Heat Stress Hazards**

During operations there is a potential for worker exposure to serious temperature extremes. These environmental conditions increase the risk of heat or cold stress during field activities. Field personnel should be trained to recognize the symptoms of heat stress and provide initial first aid treatment if required until more qualified personnel take over. Heat stress occurs when the rate of heat gain is greater than the body's ability to remove it. It is important to understand the factors that cause overheating and mechanisms to control those factors. Measures used to control heat stress exposure will include:

- briefing employees on the causes, prevention, signs/symptoms, and treatment of heat stress;
- monitoring for exposure to heat stress using a Wet Bulb Globe Thermometer (WBGT);
- proper monitoring of employee physiology including heart rate and oral temperature;
- wearing ice vests or other K-H approved measures;
- instituting a work-rest regimen based on the K-H Heat Stress Program (see Appendix D);
- providing personnel with a shaded break area and cool liquids; and
- providing for proper acclimatization of all workers to new or changing work conditions.

#### ***Effects of Personal Protective Equipment (PPE)***

Heat stress may occur with or without the use of PPE. PPE adds layers of clothing that insulate the wearer from cooling air. Chemical protective clothing generally has a vapor barrier to keep out chemical vapors.

The vapor barrier also prevents evaporative cooling of perspiration. In short, PPE increases the heat stress on workers.

### ***Practical Methods to Reduce Heat Stress***

1. Become acclimated to heat for several days whenever possible. Plan work in the cooler portions of the day. Early morning hours and evening hours are cooler.
2. Conduct site preparations before the field team dresses out. Instrument calibrations, equipment preparation, and planning for the work day, etc., should be performed before dressing in chemical PPE.
3. Take frequent breaks and consume at least one pint of cool fluid every hour. Replenish electrolytes through the consumption of diluted drinks. The body loses more water than electrolytes. Concentrated salt, electrolyte, or juices can increase susceptibility to heat stress.

### ***Heat Stress Symptoms and Treatment***

CONDITION	COMMON SYMPTOMS	TREATMENT
Slightly elevated body temperature	Temperature 100 to 101 <sup>o</sup> F Headache	Drink cool fluids. Rest in cool place until temperature and pulse are below 100 and 110 <sup>o</sup> F, respectively.
Heat rash	Rash mainly on back	Shower at the end of the shift.
Heat cramps	Muscle cramps or twitching often starting in abdominal area. Pain in hands, feet and abdominal areas.	Remove from field work. Take off PPE. Encourage consumption of cool fluids designed to replenish electrolytes (e.g., Gatorade).
Heat exhaustion *	Temperature between 99-102 <sup>o</sup> F Elevated pulse Profuse sweating Pale skin Cool wet/clammy skin Lethargic Nausea Dizziness	Remove from field work. Take off PPE. Drink cool fluids. Take to Medical Building 122. Rest in cool place. No field work for at least 48 hours.
Heat stroke *	Temperature greater than 102 <sup>o</sup> F Hot, dry skin Flushed skin Light or no sweating Rapid pulse	<b>LIFE THREATENING</b> Remove PPE. Remove from field work. Flush with cool, not cold water. Take to Medical Building 122. Written release from doctor required to return to work.

\* If in doubt about whether the condition is heat exhaustion or heat stroke, seek medical attention. Health care specialists have additional training to interpret pupillary response to light, blood pressure, and other factors.

## OCCUPATIONAL EXPOSURE STANDARDS

### Heat Stress Monitoring

The U.S. Environmental Protection Agency (EPA) and the ACGIH have published heat stress monitoring recommendations. The EPA recommends heat-stress monitoring at temperatures above 70° F when chemical PPE is used.

### Work Controls

When air temperatures exceed 70° F, the work environment may be monitored at the discretion of the HSS by means of the WBGT Index. The WBGT offers a first-order determination of the portion of heat stress due to the net effects of air temperature, radiant heat transfer, and humidity. It does not sufficiently reflect the effects of air movement on convective heat transfer or evaporative heat loss and does not account for heat produced by physical work. The following lists the ACGIH Permissible Heat Exposure Threshold Limit Values (Values are given in °C and (°F) WBGT).

Work-Rest Regimen	WORK LOAD		
	Light	Moderate	Heavy
Continuous work	30.0 (86)	26.7 (80)	25.0 (77)
75% Work			
25% Rest, each hour	30.6 (87)	28.0 (82)	25.9 (78)
50% Work			
50% Rest, each hour	31.4 (89)	29.4 (85)	27.9 (82)
25% Work			
75% Rest, each hour	32.2 (90)	31.1 (88)	30.0 (86)

The tabulated information assumes no chemical PPE is being worn. Since chemical PPE tends to increase heat stress, ACGIH has published correction factors in the same standard. **OSHA enforces the ACGIH recommendation.**

### 5.4.6 Cold Stress Hazards

Personnel working outdoors in low temperatures, especially at or below freezing point (32°F) are subject to cold stress. Exposure to extreme cold for even a short time causes severe injury to the surface of the body. Areas of the body, which have high surface-area-to-volume ratio such as fingers, toes, and ears are the most susceptible. Measures used to control cold stress exposure will include:

- briefing employees on the causes, prevention, signs/symptoms, and treatment of cold stress;
- monitoring for exposure to cold stress using a dry bulb thermometer and anemometer;
- wearing adequate insulating dry clothing when the air speed and temperature result in an equivalent chill temperature of <40° F;
- changing wet clothing;
- instituting a work-warming regimen based on the ACGIH guidelines (see Appendix C) when the equivalent chill temperature is <19.4° F;

- providing personnel with a heated break area and warm sweet drinks;
- taking special precautions when handling evaporative liquids such as gasoline at equivalent chill temperatures  $<39.2^{\circ}\text{F}$ ; and
- providing for proper acclimatization of all workers to new or changing work conditions.

Two factors influence the development of a cold injury: ambient temperature and wind velocity. Wind chill is used to describe the chilling effect of moving air in combination with low temperature.

### ***Frostbite***

Local injury resulting from cold is included in the generic term frostbite. Frostbite of the extremities can be categorized as:

- “Frost nip or incipient frostbite” which is characterized by sudden whitening of skin
- “Superficial frostbite” which is characterized by skin with a waxy or white appearance and is firm to the touch, but tissue beneath is resilient
- “Deep frostbite” which is characterized by tissues that are cold, pale, and solid

### ***Hypothermia***

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. Its symptoms are usually exhibited in five stages:

- Shivering
- Apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than  $95^{\circ}\text{F}$
- Unconsciousness, glassy stare, slow pulse, and respiratory rate.
- Freezing of the extremities
- Death

### ***Work Controls***

When personnel are working in air temperatures below  $4^{\circ}\text{C}$  ( $40^{\circ}\text{F}$ ), workers must have cold protective clothing appropriate for level of cold and physical activity to maintain core body temperatures above  $36^{\circ}\text{C}$  ( $96.8^{\circ}\text{F}$ ). To monitor air temperatures and assess cold weather work controls, air temperatures may be recorded at 4-hour intervals or more frequently at the discretion of the HSS. The following guide lists the recommended protective clothing and work controls to be performed when air temperatures fall below the corresponding levels.

< 39.2° F	Cold protective clothing to protect all parts of body from cold injury including hands, feet, and head.
< 19.4° F	Cold protective clothing to protect all parts of body from cold injury including hands, feet, and head. Workers should have access to a heated warming shelter.
< 10.4° F	Cold protective clothing to protect all parts of body from cold injury including hands, feet, and head. Workers should have access to a heated warming shelter. Worker should be under constant protective observation (buddy system or supervisor). Moderate work rates. Minimize standing or sitting still for long periods of time. Workers should be instructed in safety and health procedures including: proper rewarming procedures and appropriate first aid treatment, proper clothing practices, proper eating and drinking habits, recognition of impending frostbite, recognition of signs and symptoms of impending hypothermia, and safe work practices.

When air temperatures fall below 4° C (40° F), an ear thermometer may be used on site at the discretion of the HSS, to measure worker core body temperature. If core body temperature falls below 35° C (95° F) the worker will be taken to a warming shelter, given warm fluids, and monitored until core body temperature returns to above 36° C (96.8° F).

#### **5.4.7 Personal Protective Equipment Hazards**

PPE will be required for most activities placing a physical and mental strain on the wearer. When PPE such as SCBAs, airline respirators, gloves, shoe covers, and protective anti-C coveralls are worn, visibility, hearing, manual dexterity, and communications are impaired. Additionally, the risk of heat stress increases. Measures used to control these hazards will include:

- PPE will be inspected prior to use;
- keeping the work area clear of trip hazards through diligent housekeeping;
- providing radios for communication;
- developing hand signals for communication;
- use the buddy system to ensure clothing integrity; and
- monitoring for and preventing heat stress as described above.

#### **5.4.8 Overhead Power Line Hazards**

Special precautions must be taken when working or operating heavy equipment in the vicinity of overhead energized power lines. Contact with electrical power lines can cause shock, burns, or death. Measures used to control overhead power line hazards will include:

- assume all overhead lines are energized;
- heavy equipment will be operated with a ten foot (10') minimum clearance between power lines and any part of the equipment; and
- strictly adhering to the RFETS Occupational Safety and Industrial Hygiene Program Manual (MAN-072-OS&IH PM) when conducting lock out/tag out operations on overhead lines.

#### **5.4.9 Vehicular Traffic Hazards**

Employees shall exhibit special caution when working along active roadways. Measures used to control traffic hazards will include:

- wearing reflective vests;
- positioning flag-persons along active roadways to control traffic;
- closing roads as needed; and
- placing jersey barriers around regularly occupied work areas.

#### **5.4.10 Portable Electric Generator Hazards**

Due to a lack of permanently installed electrical power, portable electric generators may be used extensively during ER projects. Generators may be used to power portable hand tools and light stands, pumps, and the radiological air monitors. Measures used to control the hazards associated with the use of generators will include:

- extension cords will be intended for outdoor use, inspected by the user, and protected from unnecessary damage;
- any extension cords which show signs of damage or deterioration will be immediately removed from service;
- generators will be equipped with Ground Fault Circuit Interruptor (GFCI) outlets which will be tested daily by the user; generators will be properly grounded via a ground rod as required;
- a 10 lb. ABC fire extinguisher will be located next to all generators;
- refueling will be conducted at the beginning of the shift when the generators are cool; and
- refueling will be conducted with the generator on the ground surface or with the generator grounded to the fuel dispenser.

The RFETS Lock Out/Tag Out Program (MAN-072-OS&IH PM) will be *strictly* adhered to during the servicing and maintenance of machines or equipment in which the unexpected energization or start up of the machine or equipment, or release of stored energy could cause injury to personnel.

#### **5.4.11 Hand Tool Hazards**

The improper use of hand tools can result in injury to personnel and damage to property. Measures used to protect personnel and equipment will include:



- hand tools will be inspected by the user prior to use;
- hand tools will be used for their intended use and operated in accordance with MAN-072-OS&IH PM;
- guards will be in place and no modifications will be made;
- portable power tools will be plugged into GFCI protected outlets; and
- portable power tools will be Underwriters Laboratory (UL) listed and have a three wire grounded plug or be double insulated.

#### **5.4.12 Compressed Gas Hazards**

Compressed gas cylinders and systems pose a hazard to personnel and property due to unknown contents, misuse, and rupture. The use of compressed gas cylinders and systems include those associated with the supplied airline respirators, self-contained breathing apparatus (SCBA) systems, and Industrial Hygiene and Radiological Control Technicians operations. Measures used to control the use of compressed gas cylinders and systems will include:

- obtaining certification papers with all breathing air or other compressed gas shipments;
- ensuring that all cylinders and systems are properly labeled;
- inspecting cylinders and systems prior to and during each shift;
- restricting smoking in areas where cylinders containing flammable gases are stored;
- heavy equipment operators will inspect heavy equipment mounted airline bottles prior to and during each shift;
- securing cylinders in the upright position; and
- properly tightening all fittings and connections.

#### **5.4.13 Hoisting and Rigging Equipment Hazards**

Hoisting and rigging equipment poses a unique hazard due to sudden failure resulting in property damage or personal injury. Measures used to control the use of hoisting and rigging equipment will include:

- hoisting equipment from off site vendors will be inspected by K-H Health and Safety;
- operators will be properly trained in the use and limitations of the specific pieces of hoisting equipment being operated;
- use of Hoisting and Rigging Checklist as required by MAN-072-OS&IH PM;
- hoisting equipment will be inspected by the operator prior to the beginning of each shift and an inspection checklist will be completed;
- rigging equipment will be properly tagged, if required, and inspected by the user prior to use on a daily basis;

- any rigging equipment which show signs of damage or deterioration will be immediately removed from service;
- ensuring that all rigging equipment is properly positioned;
- at no time will any personnel position themselves under hoisted loads;
- ground personnel will wear orange vests and maintain line of site with the operator; and
- a Hoisting and Rigging Plan will be developed for all critical lifts.

#### **5.4.14 Fork Truck Hazards**

The operation of fork trucks pose a hazard to personnel, equipment, and property. Control measures for the safe operation of fork trucks will include:

- fork truck operators will hold a current Fork Truck Operator Permit;
- fork trucks will be inspected by the operator prior to the beginning of each shift and an inspection checklist will be completed;
- ground personnel will wear orange vests and maintain line of site with the operator; and
- all loads will be secured.

#### **5.4.15 Ladder Hazards**

Work on ladders poses a hazard due to falls and ladder failure. Control measures for the use of ladders will include:

- ladder users will have current Ladder Safety Awareness training;
- ladders will be Type 1-A, Industrial Extra Heavy Duty or better;
- aluminum ladders will not be used in areas where there is electrical power equipment;
- three legged ladders are strictly prohibited;
- ladders will be inspected by the user prior to use on a daily basis;
- ladders which show signs of damage or deterioration will be immediately removed from service;
- ladders will be used for their intended purpose; and
- work on ladders at heights greater than six feet will require evaluation from the SSO.

#### **5.4.16 Elevated Work Hazards**

Unprotected elevated work at heights greater than six feet poses a hazard due to the potential for falls. Prior to wearing fall arrest equipment, attempts will be made to eliminate the hazard. If, however, the hazard cannot be eliminated and fall arrest equipment must be worn, the following control measures will be followed:

- personnel shall have current Fall Protection qualification;

- fall arrest equipment will be inspected by the user prior to use on a daily basis;
- fall arrest equipment which show signs of damage or deterioration will be immediately removed from service; and
- the fall arrest system will consist of a full body harness, shock absorbing lanyard, and an approved anchorage point.

#### **5.4.17 Flammable or Combustible Liquid Storage Hazards**

Hazards associated with improper flammable or combustible liquid storage include fires and spills. Work controls involved with flammable or combustible liquid storage include:

- gasoline containers will be metal safety cans in good repair;
- containers will be equipped with spring loaded closing devices and flame arresters;
- containers will be properly labeled; and
- containers will be stored in approved flammable storage cabinets when not in use.

#### **5.4.18 High Temperature, High Pressure Decontamination System Hazards**

Should the use of a high temperature, high pressure decontamination system be required in the field, personnel will have current Pressure Safety II training and the following control measures will be implemented:

- personnel will be briefed on the use of the system;
- the wand, trigger mechanism, hoses, and temperature/pressure generating unit will be inspected by the user prior to use;
- at no time will the wand be pointed at any body part or other personnel; and
- polycoated Tyvek®, 16" high steel toed rubber boots, safety glasses, hard hat with face shield, and inner and outer nitrile gloves will be worn at a minimum.

#### **5.4.19 Hydraulic Powered Tools, Pneumatic Powered Tools and Compressor Hazards**

The use of hydraulic and pneumatic powered tools and compressors poses a hazard to personnel. Control measures for the safe operation of pneumatic power tools and compressors will include:

- hydraulic and pneumatic power tools and compressors will be inspected by the user prior to use;
- pneumatic and hydraulic powered tools and compressors will be used for their intended use and operated in accordance with MAN-072-OS&IH PM;
- guards will be in place and no modifications will be made;
- pneumatic power tools shall be secured to the hose or whip by some positive means to prevent the tool from becoming accidentally disconnected;

- the manufacturer's safe operating pressure for hoses, pipes, valves and other fittings shall not be exceeded; and
- all pneumatic hoses exceeding ½-inch inside diameter shall have a safety device at the source of supply or branch line to reduce pressure in case of hose failure.

The use of hoses for hoisting or lowering tools shall not be permitted.

#### **5.4.20 Adverse Weather Conditions**

Adverse weather conditions may contribute to slip, trip, and fall hazards at the site. All work areas shall be kept free of tripping hazards, free of water, ice or snow to the extent necessary to perform the required work in a safe manner. Slip, trip, and fall control measures include:

- Daily inspection shall be conducted by the HSS to assure the work area is free of trip/fall hazards;
- ice and snow shall be removed or treated with gravel in work areas to provide a safe walking surface; and
- equipment located in the work area that could present a trip hazard should be labeled with yellow and black striped caution tape.

##### **5.4.20.1 Tornado**

The tornado season in Colorado is from April to October. The majority of the tornados occur in the early summer months. When tornado conditions threaten the RFETS, all activities are regulated by the RFETS Shift Superintendent in accordance with 1-15200-EPIP-12.11, *Tornado Response*.

#### ***Tornado Watch vs. Tornado Warning***

A *tornado watch* means weather conditions are favorable for the development of tornados in the area. Information on a watch is given over radio and the Site Emergency Address System.

A *tornado warning* means a tornado has actually been sighted in the area. Information on a warning is given over radio and the Site Emergency Address System. Call the Shift Supervisor or X2911 to report a tornado.

#### ***In Case Of a Tornado Warning***

When warning sirens sound, seek inside shelter, preferably in a basement or below-ground evacuation location. A steel-framed or reinforced concrete building provides some shelter protection. Do not seek shelter within a trailer.

In a multi-story building, seek shelter in an interior hallway on a lower floor. Stay away from outside walls and glass windows or partitions.

While in the shelter, keep listening to your radio for the latest tornado advisory information and remain there until the "All Clear" signal has been given over the radio. There may be areas of the Site where the sirens are difficult to hear, if you work in one of these areas a radio should be monitored.

#### **5.4.21 Smoking, Alcohol, Drugs, and Firearms**

Smoking or other sources of ignition shall not be permitted in areas where flammable or explosive materials are stored or are present. All such areas shall be conspicuously posted: NO SMOKING OR OPEN FLAMES. Smoking is prohibited inside all of the buildings, enclosures, and trailers at the RFETS site. Smoking is allowed outside only in designated non-fire-danger areas only. Smoking debris is to be placed in authorized receptacles only.

Alcoholic beverages, illegal drugs, and firearms are strictly prohibited at any RFETS facility or remediation site.

### **6.0 PROJECT ORIENTATION AND TRAINING**

#### **6.1 Site-Specific Health and Safety Orientation**

A site-specific Hazard Communication briefing will be conducted for all employees, including subcontractors, prior to commencement of field activities. The following topics will be discussed at this briefing:

- Names of health and safety personnel and alternates responsible for site health and safety;
- Contents of the HASP;
- Work practices by which employees can minimize risks from hazards;
- Medical surveillance requirements, including recognition of symptoms and signs which might indicate overexposure to hazards;
- Health and safety organization;
- Hazards at the site including chemical, radiological, physical, and biological;
- Location and review of MSDSs for all hazardous chemicals on site;
- Exposure risk;
- Personal protective equipment to be used;
- Employee rights and responsibilities and location of DOE form F5480.4, "Complaint Form";
- General subcontractor, lower-tier subcontractor and/or vendor responsibilities;
- Location of the approved HASP;
- First aid and medical facilities;
- Emergency response procedures including local warning and evacuation systems;
- Specific occupational health and safety procedures applicable to the project;
- The Hazard Communications Program;
- Employees access to exposure monitoring data and medical records;

- Construction hazard recognition and the procedures for reporting or correcting unsafe conditions;
- Procedures for reporting accidents or incidents;
- Fire prevention and control;
- Alcohol and drug abuse policy; and
- Disciplinary actions for safety infractions and violations.

It is the employee's responsibility to ensure he/she is familiar with the contents of the HASP and HASP

Addenda relating to their specific job tasks. If at anytime, an employee does not feel they understand the contents of the HASP, another briefing shall be administered. Once the briefing is completed and employees understand the contents of the HASP, they will be required to sign the Safety Compliance Agreement form acknowledging they understand and agree to comply with this HASP.

## **6.2 General Safety and Health Training Requirements**

All on-site employees are required to obtain clearance from the Project Manager or the SSO before beginning work at this site. Training requirements for specific individuals will depend on the tasks to be performed and associated hazards or risks, and safety requirements.

### **6.3 Safety Training**

OSHA requires that employees engaged in construction activities, such as this project, will be properly trained for specific job responsibilities; all training will be documented. Employees will not participate in field activities until they have been trained to a level required by their job function and responsibility. All training and field experience will be verified and the SSO shall maintain records in the Project Support Office. HSSs are required to have current Red Cross first aid, cardiopulmonary resuscitation, and blood borne pathogens training. All other training requirements are summarized in Table 6.1 and must be current.

Subcontractor personnel shall complete the required Site-specific and job-specific training appropriate for the work performed. Table 6.1 below identifies the training required to execute remediation work at the site. At all times, the Subcontractor shall maintain personnel training records on Site.

The following training requirements are provided as guidance. Specific training requirements will be determined for each project based on the type of work to be performed and associated job hazards. Specific training requirements will be detailed in the project documentation. While this matrix may not be complete, it is expected to contain the majority of the training requirements.

The training requirements are divided into three parts based on applicability. Part 1 contains training requirements that must be completed prior to any worker performing field tasks. Part 2 contains training requirements that are required for specific job classifications. Part 3 contains training requirements that may be required for personnel regardless of their classifications, depending on the project-specific tasks and hazards present.

**Table 6.1 Training Requirements**

Part II: Required for ALL Field Personnel			
Required Training and Certifications	Site-Specific Training	Subcontractor-Supplied Training	Applicability
General Employee Training	✓		Any worker with radiological worker training that requires access to the Site.
Radiological Worker II Training	✓		All workers except RCTs that require unescorted access in areas posted for radiological concerns. Allows access to CA, HCAs, airborne areas, soil contamination areas, RBAs, RAs, HRAs and VHRAs.
Hazardous Waste Operations and documented On the Job Training (OJT)		✓	Any worker engaged in hazardous substance removal or other related activities. Most characterization and remediation workers require 40-hour training. A few workers that are unlikely to be exposed over permissible exposure limits for the hazardous substances may require the 24-hour training. 8-hour refresher is required for continued qualification for both. All certificates must reflect that coursework met the requirements of CFR 1910.120.
Medical Surveillance and Approvals		✓	Required for all Hazardous Waste Operations workers.
Lockout/Tagout Worker Awareness Training			Any worker that works under lockout/tagout but do not install lockout/tagout
Part I(a): Required for Field Supervisory Personnel			
Respirator Indoctrination for Managers and Issuers	✓		Any supervisor of workers whose job assignment requires a quantitative respirator fit.
Hazardous Waste Operations Supervisor		✓	Any supervisor that oversees fieldwork by remediation or characterization staff.
Radiological Control Manual Training for Managers	✓		Any manager that has radiological workers within their supervision.

Part 2: Training Required for Specific Job Classifications				
	Required Training and Certifications for Field Personnel	Site-Supplied Training	Subcontractor-Supplied Training	Applicability
<b>Electricians &amp; those that work on energized systems</b>	Electrical Safety CPR		✓	Any worker assigned to be the second person by the two-man rule when work is being completed on energized systems operating at 50V or more.
	Electrical Safety for Electrical Workers	✓		Any electrical worker and their supervisor(s) as identified in OS&IH Ch 36.
	Lineman Bucket Truck Training		✓	Any lineman who operates a bucket truck and their supervisor(s).
	Lockout/Tagout Fundamentals	✓		Any worker or manager involved in the application, removal or maintenance of Lockout/Tagouts.
	Lockout/Tagout Practical Application	✓		Any worker or manager involved in the application, removal or maintenance of Lockout/Tagouts.
	Lockout/Tagout Supervision/Managers Brief	✓		Any manager or administrator of the Lockout/Tagout program and supervisors of workers that perform any of the Lockout/Tagout function.
<b>RCTs</b>	Radiological Control Technician Qualification Training	✓		All RCTs and supervisors of RCTs – this training replaces the requirements for radiological worker training for RCTs.
	Sealed Radioactive Source Control - RCT	✓		All RCTs and supervisors of RCTs.
<b>Equipment Operators</b>	Equipment operator training		✓	Specialized industrial equipment/vehicle operator (SIE/V) certification and DOT certification
<b>Skilled Trades</b>	Licenses, Certifications & other credentials (Federal, State, Local, etc.)		✓	Skilled trades required by the Statement of Work
<b>Waste Generator</b>	Waste Generator All Areas - Classroom	✓		All workers who package or manage waste.
	Waste Generator All Areas – Qualification	✓		All workers who package or manage waste.
	RCRA Waste Generator Annual Training (Checklist)	✓		All workers who package or manage waste.
	Waste Determination/WSRIC Classroom	✓		All workers who package or manage waste.
	RCRA Waste Management - Classroom	✓		All workers who package or manage waste.
	RCRA Waste Management - Qualification	✓		All workers who package or manage waste.
	Waste & Environmental Management System (WEMS)	✓		All workers who package or manage waste.



Part C: Training Required for Specific Tasks or Hazards (regardless of job classification)				
	Required Training and Certifications for Field Personnel	Site-Supplied Training	Subcontractor-Supplied Training	Applicability
Office Work	General Employee Radiological Training	✓		Any worker requiring access to the site that does not require Radiological Worker Training.
	Unclassified Computer Training	✓		Any worker that requires access to the government owned unclassified computer system.
Asbestos Awareness	Asbestos Awareness		✓	Any worker involved in tasks described in Ch 19 of the OS&IH PM.
High Potential for Beryllium Exposure	Beryllium Worker	✓		Any worker performing work in Beryllium Regulated Areas or in areas where training is required by building management or by Ch 28 of the OS&IH PM.
High Lead Exposure	Lead In the Workplace		✓	Any workers that may be exposed to lead levels above the permissible threshold levels as identified by Industrial Hygiene.
Confined Space	Confined Space Entry Awareness		✓	Any worker that will perform work in confined spaces as described in OS&IH PM Ch 21.
Electrical Work	Electrical Safety for Non-Electrical Workers		✓	Any worker at risk of electric shock while working on or near energized electrical equipment or system as identified in OS&IH PM Ch 36.
Elevated Work	Fall Protection Awareness		✓	Any worker that works in an area where it is possible to fall 6 feet or more.
	Bucket Truck Safety		✓	Any user of bucket trucks and their supervisor(s).
	Aerial Lift Safety Training		✓	Any user of aerial lift and supervisor(s).
	Ladder Safety Awareness		✓	Any worker who uses a ladder (Fall Protection Awareness Training includes Ladder Safety Awareness Training).
Forklift Operation	Powered Industrial Truck Operator Training		✓	Any worker who operates a PIT.
	Powered Industrial Truck Safety Training Evaluation	✓		Any worker who operates a PIT (training is PIT specific).
	Powered Industrial Truck Hazard Awareness	✓		Any worker who operates a PIT.
High Noise Areas	Hearing Conservation		✓	Employees exposed to noise at or above an 8-hour time weighted average of 85 dBA shall participate in a training program that shall be repeated annually for each employee. Also includes any worker identified by Industrial Hygiene or Occupational medicine as participants in the program.
Hoist/Apparatus Work	Hoist Apparatus Training		✓	Any worker who operates hoists or cranes and supervisor(s).
Packaging and Shipping Tasks (samples and waste containers)	DOT Awareness	✓		Any worker and their direct supervisor/foreman involved in the packaging, marking, and transport of hazardous or radioactive materials.
	DOT Federal Motor Carrier Safety: Cargo Tie Down		✓	Any worker responsible for safe securement of materials on or in cargo vehicles.

Part 3: Training Required for Specific Tasks or Hazards (as defined in the Safety Plan)				
	Required Training and Certifications for Field Personnel	Site-Supplied Training	Subcontractor-Supplied Training	Applicability
<b>Pressurized Systems</b>	Pressure Safety Awareness		✓	Any worker that dismantles, operates, tests, maintains, inspects or transports 0 to 150 psig pressure systems and gas cylinders up to 4600 psi and supervisor.
<b>Respiratory Protection</b>	Respirator Fit		✓	Any worker who requires respiratory protection for performing assigned tasks. The types of respiratory protection include air-purifying respirators, powered air-purifying respirators, self contained breathing air, and supplied air. The types of respiratory protection the worker is qualified to use must be specified on the worker's qualification card.
	Medical Qualification		✓	Any worker who requires respiratory protection must have medical certification that they are fit for duty.
	Respirator Indoctrination - User		✓	Any worker who requires a respirator for performing assigned tasks.
	Self contained breathing air practical	✓		Workers using self-contained breathing air must also receive practical training from the fire department on its use.
<b>Routine Access to Buffer Zone or Specific Buildings</b>	Building Indoctrination	✓		Any worker that requires regular access to a building (training is building specific). Includes Buffer Zone Orientation
	Alarms, Sounds and Responses	✓		Any worker requiring unescorted access in PA and 400 and 800 areas.
<b>Scaffolding</b>	Scaffolding Safety for Builders/Erectors		✓	Any worker who erects, dismantles, inspects maintains, or modifies scaffolding or functions as the OSHA-defined "competent person" during scaffold use.
	Scaffolding Safety for Competent Persons		✓	Any worker who functions as the OSHA-defined "competent person" during scaffold use.
<b>Spark producing or hot work activities</b>	Fire Watch/Compensatory Measures	✓		Any worker designated to perform the duties of fire watch for the purpose of providing a compensatory measure due to an inoperable fire detection component.
<b>Welding</b>	Welding Safety		✓	Any worker and their direct supervisor/foreman that works around or uses welding equipment or those worker who function as the fire watch during welding operations.

## **7.0 PERSONNEL PROTECTION EQUIPMENT**

All personnel will require use of Level D PPE. The use of Level D PPE is defined by the following criteria:

- No contaminants are present, or contaminants are present below the action levels established in the HASP for respirator use; and
- Work functions preclude splashes, immersion, or potential for unexpected inhalation of any chemicals.

Level D is the minimum fieldwork uniform affording minimal skin protection and no respiratory protection. It consists of the following PPE:

- Approved above the ankle leather work boots/shoes with ANSI Z41.1 toecaps;
- Heavy-duty leatherwork gloves (as required);
- Safety glasses (ANSI Z87.1 approved) with side shields;
- Reflective vests (as required); and
- Hard hat (ANSI Z89.1 approved).

## **8.0 EXPOSURE MONITORING**

Monitoring of the environmental conditions in and around the construction site must occur because of the potential for unsafe conditions to be present. The following sections describe the monitoring program to be implemented and appropriate exposure limits and action levels (see Table 8.1). Where feasible, personnel exposures to hazardous conditions shall be maintained within the TLVs adopted by the ACGIH or the PELs adopted by OSHA, whichever is more stringent.

### **8.1 Noise Monitoring**

Noise levels may be monitored to delineate areas or activities where hearing protection and postings are required, the effectiveness of hearing protection, and whether or not personnel need to participate in a Hearing Conservation Program. Daily calibrations of instrumentation shall be per the manufacturer's specifications and results will be entered in the Industrial Hygiene Instrumentation Calibration Logbook. Annual calibration and service of the instrument and the calibrator is required.

### **8.2 Wind Speed Monitoring**

Wind speed may be monitored in accordance with the Project Specific HASP Addenda, to ensure compliance with PRO-W08-EP-6.16, "Severe Weather Conditions".

### **8.3 Heat Stress Monitoring**

Heat stress monitoring may be completed using the appropriate instrumentation. The WBGT reading displayed by the instrument, in either Fahrenheit or Celsius, is a weighted sum of the dry bulb, wet bulb, and

venter globe temperatures. The WBGT is factory calibrated on an annual basis. Maintenance is minimal with only the wet bulb wick requiring periodic replacement. Monitoring frequency will depend on the work area temperature, the type of work being performed, and the type of PPE worn. Refer to the ACGIH table found in Appendix D. Readings in the field will be logged on the Daily WBGT Log.

### **8.4 Cold Stress Monitoring**

Cold stress monitoring may be accomplished by obtaining the air temperature and the wind speed and calculating the equivalent chill temperature using the ACGIH table found in Appendix D. Once in the field, wind speed, temperature, and equivalent chill temperature will be logged on the Daily Wind Speed/Cold Stress Log.

### **8.5 Radiological Monitoring**

To ensure that any possible radiological contamination is maintained ALARA, equipment will be monitored using the techniques, which are discussed in the following section.

#### **8.5.1 Equipment Monitoring**

All anchor driving equipment and materials used may be surveyed and released by RCTs in accordance with the RFETS Radiation Safety Practices Manual.

Instrumentation to be used for personnel and equipment contamination monitoring are those recommended by RFETS Radiological Safety and consist of the following:

- NE Technology, Model Electra, with dual alpha/beta probe;
- Eberline, Model SAC-4, alpha smear counter;
- Eberline, Model BC-4, beta/gamma smear counter;
- Ludlum, Model 2929, alpha and beta/gamma smear counter;
- Science Applications International Corp., Model AP-2, portable alpha analyzer.

RFETS Radiological Engineering may approve any alternate instruments. All instruments will be maintained, calibrated, performance tested, and used in accordance with the RFETS Radiological Operating Instructions Manual.

### **8.6 Respirable Dust Monitoring**

Respirable dust monitoring may be accomplished using a real-time aerosol monitor (e.g., Miniram). The instrument may be calibrated using a dust free Z-Bag prior to each use and periodic cleaning of the sensing

chamber is required. Calibration on each shift will be per the manufacturer specifications and results will be entered in the Industrial Hygiene Instrumentation Calibration Logbook. A yearly factory calibration and servicing is recommended. Monitoring should be conducted during all dust generating activities.

## **8.7 Combustion Gases Monitoring**

Monitoring for combustion gases may be done using the appropriate instrumentation equipped with percent oxygen, percent lower explosive limit, carbon monoxide, nitrogen dioxide, and sulfur dioxide sensors. The instrument shall be calibrated daily prior to use and requires factory calibration and service on a yearly basis. Daily calibration will be per the manufacturer's specifications and results will be entered in the Industrial Hygiene Instrumentation Calibration Logbook.

Monitoring for nitric-oxide will be accomplished using a instrumentation equipped with nitric-oxide colorimetric tubes. The tubes typically have a range of 2.5-200 ppm. The hand held sampling pump is leak tested daily prior to use.

**Table 8.1 Monitoring Program Summary**

<b>NOISE</b>			
<b>Hazard</b>	<b>Action Level</b>	<b>Action(s) to be Taken</b>	<b>Monitoring Frequency</b>
Short term high noise levels	>85 dBA	Don suitable hearing protection. Initiate noise dosimetry	As needed to characterize new equipment and/or operations and confirm adequacy of hearing protection
Continuous high noise levels	>85dBA average over 8-hour shift	Don suitable hearing protection. Participation in a Hearing Conservation Program.	As needed to characterize equipment and/or operations and confirm adequacy of hearing protection

<b>WIND SPEED</b>			
<b>Hazard</b>	<b>Action Level</b>	<b>Action(s) to be Taken</b>	<b>Monitoring Frequency</b>
Personnel injury	> 15 mph average for two consecutive 15-minute periods.	Suspend or modify crane or personnel highlift operations at the discretion of the Project Manager and the SSO.	Continuous during all field activities.
Personnel injury	Any wind speed at which the equipment operator feels the crane operation is unsafe.	Suspend or modify crane or personnel highlift operations at the discretion of the Crane operator, Project Manager, and the SSO.	Continuous during all field activities
Personnel injury	> 30 mph average for two consecutive 15-minute periods.	Crane operation and personnel high lift equipment operations must be approved by Kaiser-Hill safety supervision.	Continuous during all field activities.
Personnel injury	> 45 mph average for two consecutive 15-minute periods.	Secure area and terminate crane operation and personnel high lift operation. Limited ground activities approved by Kaiser-Hill Safety Supervision.	Continuous during all field activities
Personnel injury	> 55 mph average for two consecutive 15-minute periods.  (Whole Gale Warning)	Suspend all outdoor work except emergency activities.	Continuous during all field activities.

**Table 8.1 Monitoring Program Summary (Continued)**

HEAT STRESS			
Hazard	Action Level	Action(s) to be Taken	Monitoring Frequency
Heat stress	Varies depending on work load and if PPE is worn. <sup>1</sup>	Work-rest regimen, ice vests, or other KH approved measures.	Varies depending on work load and if PPE is worn. <sup>1</sup>
<sup>1</sup> Monitoring will be performed when work area temperature exceeds 77°F. See Appendix C for guidance and action levels for work involving the use of personal protective equipment.			

COLD STRESS			
Hazard	Action Level	Action(s) to be Taken	Monitoring Frequency
Cold stress	40°F Equivalent chill temperature <sup>1</sup>	Wear adequate insulated dry clothing	Continuous when the equivalent chill temperature is <40°F
Cold stress aggravated by the use of evaporative liquids such as gasoline	39.2°F Equivalent chill temperature	Avoid soaking clothing or gloves with evaporative liquids	Continuous when the equivalent chill temperature is <40°F
Cold stress	19.4°F Equivalent chill temperature	Work-warm regimen will be instituted <sup>2</sup>	Continuous when the equivalent chill temperature is <40°F
<sup>1</sup> Equivalent chill temperature is the combined effect of the air temperature and wind speed. See Appendix C for ACGIH table used to calculate equivalent chill temperature.			
<sup>2</sup> See Appendix C for ACGIH work-warm regimen schedule			

RADIATION			
Hazard	Action Level	Action(s) to be Taken	Monitoring Frequency
Equipment and material contamination	Alpha contamination: >20 dpm/100cm <sup>2</sup> removable >100 dpm/100cm <sup>2</sup> total average. Not to exceed >300 dpm/100cm <sup>2</sup> total maximum. Beta/gamma contamination: >1000 dpm/100cm <sup>2</sup> removable >5000 dpm/100cm <sup>2</sup> total. average. Not to exceed >15000dpm/100cm <sup>2</sup> total maximum.	Suspend operations, secure area and notify the Project Manager and Radiological Engineering.	Baseline surveys on anchor driving equipment prior to use.  Unrestricted release surveys prior to the equipment leaving the site.

Respirable Dust Monitoring			
Hazard	Action Level	Action(s) to be Taken	Monitoring Frequency
Nuisance dust	1.5 mg/m <sup>3</sup>	Spray water for dust suppression to maintain below 1.5 mg/m <sup>3</sup>	Continuous during dust generating activities.
Combustion Gases Monitoring			
Hazard	Action Level	Action(s) to be Taken	Monitoring Frequency
Nitrogen Dioxide	1.5 parts-per-million	Suspend operations and notify the Field Supervisor	During all work activities inside the enclosure when necessary, at the discretion of the HSS or SSO.
Sulfur Dioxide	1.0 part-per-million	Suspend operations and notify the Field Supervisor	During all work activities inside the enclosure when necessary, at the discretion of the HSS or SSO.
Carbon Monoxide	12.5 parts-per-million sustained in the breathing zone for 10 seconds	Suspend operations involving CO generation - notify the Field Supervisor and KH IH. Project Management in concurrence with IH will evaluate and approve methods to mitigate the hazard.	During all work activities inside the enclosure when necessary, at the discretion of the HSS or SSO.
Nitric Oxide	12.5 parts per million	Suspend operations and notify the Field Supervisor	During all work activities inside the enclosure when necessary, at the discretion of the HSS or SSO.

## 9.0 CONTROL OF REMEDIATION SITE ACCESS

### 9.1 Site Control

Site control is necessary to prevent unauthorized, untrained, or unprotected personnel or visitors from being exposed to the hazards associated with the site. During activities at the remediation/construction site, site control measures may include the following:

- All personnel and visitors are required to enter their name, time in, and time out on the sign in sheet located at the access control point;
- A chain link fence may be installed around the site for security and site control;
- Posting signage that communicates information such as required personal protective equipment and work zone boundaries; and
- Securing all work areas at the end of each workday.



Some remediation sites will be posted as Underground Radioactive Material Area's (URMA) and access into the posted area is limited to trained personnel only. The minimum training requirements for entry into a

URMA is General Employee Radiological Training (GERT) or Radiological Worker Training I (Rad Worker I) and if ever a time arises that project personnel need to enter the posted area the SSO or the HSS need to be notified prior to entry.

## **10.0 CONSTRUCTION HEALTH AND SAFETY BULLETIN BOARD**

In order to promote safety and maintain a highly visible safety profile on the project site, a Health and Safety Bulletin Board may be posted in the office trailer break area. Postings will provide related information, such as:

- Project Information card;
- Required OSHA postings, Worker's Compensation posters, DOE informational and complaint postings, etc; and
- Relevant safety posters and safety information (i.e., PPE requirements of the work area).

The project health and safety staff personnel will maintain the bulletin board assisted by other project personnel.

## **11.0 SANITATION**

Potable water washing and toilet facilities, which comply with 29 CFR 1926.65(n) Sanitation at Temporary Work Places, will be available to all on-site personnel.

## **12.0 EMERGENCY RESPONSE**

Potential emergencies during work at the RFETS include hazardous substance release, employee contamination, accidents, injuries, fire, and natural disasters. Safety precautions will be taken to avoid emergencies. However, if an emergency does arise, the procedures described in this section will be followed. Also, preparatory steps necessary for responding to an emergency are given below and they should be complied with before beginning any work at the site.

The Project Manager, with assistance from the Field Supervisor and the SSO, has responsibility and authority for coordinating all evacuations and emergency response activities until proper authorities arrive and assume control.

### **12.1 Site Evacuation**

If an evacuation is necessary at the remediation site, personnel will exit the site via the nearest exit and proceed to the designated primary assembly area. An audible alarm system (such as a pre-planned number of short blasts with an air-horn) will indicate an emergency evacuation during which personnel will

immediately evacuate the site. All personnel will be accounted for once they reach the assembly area by using the access control point sign-in log.

The assembly areas will be designated in the appropriate HASP addenda.

## **12.2 Emergency Services**

### **12.2.1 Emergency Phone Numbers**

In case of an emergency, RFETS emergency services must be notified. Kaiser-Hill maintains an emergency response telephone extension of 2911 at RFETS. Extension 2911 may be reached from any plant site telephone or on Radio Channel 2911 and will immediately connect the caller with the Fire Department, Plant Security, the Central Alarm Station, the Shift Superintendent and, during first shift, Occupational Health. Table 12.1 presents a list of key site project personnel who will be notified in the event of any spill, release, employee contamination, accident, injury, fire, or natural disaster. These telephone, radio and pager numbers will be posted next to telephones and at prominent locations at the site.

Any revisions to the list must be posted and all personnel notified of the changes.

\*All Life Threatening Emergencies: Dial Extension 2911

### **12.2.2 Rocky Flats Occupational Health Medical Facility (Building 122)**

The Rocky Flats Medical Facility in Building 122 is to be used for medical injuries and emergencies. Depending on the seriousness of the injury, injured personnel may also require care by an off-site hospital. The need for off-site care will be determined by Occupational Health.

A map to Building 122 will be posted next to telephones and at prominent locations at the site.

#### **12.2.2.1 Clinic Hours**

The medical clinic located in Building 122 is operated during the following business hours:

Monday & Tuesday	6:30 AM - 4:30 PM
Wednesday & Thursday	6:30 AM - 6:30 PM
AWS Fridays	6:30 AM - 3:30 PM

Personnel requiring medical attention outside of clinic hours are to be transported to the Rocky Flats Fire Department in Building 331 on Central Avenue. If the injury or illness requires more than First Aid the Rocky Flats Fire Department should be called at 2911.

**Table 12.1 Emergency Telephone Numbers**

RFETS EMERGENCY RESPONSE EXTENSION	RFETS Phone: 2911 RFETS Radio: 2911
RFETS SHIFT SUPERINTENDENT	RFETS Phone: 2914 RFETS Radio: 3301
<b>RMRS Emergency Contacts</b>	
Lane Butler K-H ER Program Manager	RFETS Phone 966-5245 RFETS Pager 212-3017
Lee Norland K-H ER Decision Management Manager	RFETS Phone: 966-5223 RFETS Pager: 212-1966
Annette Primrose K-H ER Field Operations Manager	RFETS Phone: 966-4385 RFETS Radio: 3801 RFETS Pager: 212-6338
Marla Broussard K-H ER Engineering and Documentation Manager	RFETS Phone: 966-6001 RFETS Radio n/a RFETS Pager: 212-6261
Mike Bemski Field Operations Supervisor	RFETS Phone: 966-4090 RFETS Radio: 3720 RFETS Pager: 212-6271
Mark Burmeister Field Operations Supervisor	RFETS Phone: 966-5891 RFETS Radio 3750 RFETS Pager: 212-6228
Tom Lindsay Field Operations Supervisor	RFETS Phone: 966-5705 RFETS Radio 3757 RFETS Pager: 212-5681
Tracey Spence Field Operations Supervisor	RFETS Phone: 966-4322 RFETS Radio 3700 RFETS Pager: 212-6575
David Strand Field Operations Supervisor	RFETS Phone: 966-6422 RFETS Radio 3745 RFETS Pager: 212-2288
Andre Gonzalez Health and Safety Supervisor	RFETS Phone: 966-6727 RFETS Radio: n/a RFETS Pager: 212-6636
Curtis Bean Radiological Safety Manager	RFETS Phone: 966-2069 RFETS Radio: n/a RFETS Pager: 212-3810
Chad Blake Radiological Engineer	RFETS Phone: 966-5909 RFETS Radio: n/a RFETS Pager: 212-2079

## **12.3 Accident/Injury**

In case of an accident or other event that causes injury to personnel present at the RFETS project remediation site, immediately notify Site Supervisor and/or SSO. If supervisors are not available, the RFETS emergency extension at 2911 should be notified immediately. The site Fire Department, EMTs, and Security will be dispatched immediately. Details of the emergency and the exact location must be given over the telephone. Once RFETS emergency services have been notified, the Project Manager and Health and Safety Supervision personnel must immediately be contacted. Basic first aid may be administered by properly trained personnel until emergency medical personnel arrive. Each shift should have a minimum of one staff member trained in American Red Cross First Aid and CPR. Any non-emergency medical situation such as minor cuts or sprains should be attended to at RFETS Medical - Building 122.

### **12.3.1 Emergency Medical Procedures**

For severe injuries, illnesses, or over exposures:

- Remove the injured or exposed person(s) from immediate danger if safe to do so;
- Immediately call extension 2911 and provide as much information as possible; and
- Render emergency first aid until emergency medical personnel arrive.

### **12.3.2 Fire/Explosion**

The first responsibility of any employee discovering a fire is to warn coworkers and call the Rocky Flats Fire Department at extension 2911.

**UNDER NO CIRCUMSTANCES SHOULD ANYONE ATTEMPT TO FIGHT A FIRE ALONE.**

Personnel trained as First Responders may then use a fire extinguisher or de-energize small fires in those situations where there is no personal danger in doing so. Fire extinguishers are located next to all generators on-site, and in all pieces of heavy equipment.

In case of an explosion, all personnel will be evacuated and the fire department notified. No personnel shall re-enter the area until it has been cleared by the Rocky Flats Fire Department.

### **12.3.3 Natural Disasters**

Natural disasters may occur at the site and include lightning and high winds.

- Lightning - Persons should not work in open areas, near trees or other equipment outside during lightning storms - Stop work and clear the site until storm passes;
- If high winds are forecast, the site should be cleared before the winds become hazardous. Workers should be instructed to go to an appropriate shelter. If winds are sustained at 45 miles per hour, all work will be evaluated and approved on a case-by-case basis; and
- Notify the Project Manager or Field Supervisor of any work stoppage due to lightning and high winds.

## 12.4 Emergency Equipment

A spill kit will be located at appropriate locations selected during site mobilization. The universal sorbents contained in the spill kit should be effective for a wide range of liquids including acids, bases, solvents, and lubricants eliminating the need for specific sorbents for specific spills. The spill kit may contain the following items:

- Sorbent socks/booms;
- Sorbent pillows;
- Sorbent pads;
- disposal bags;
- pair SilverShield gloves;
- pair nitrile gloves;
- pair goggles;
- pair Tyvek QC coveralls, XL;
- non-sparking scoop;
- plastic non-sparking shovel;
- floor-stand spill sign;
- dry acid neutralizer;
- dry base neutralizer;
- pH paper;
- repair putty stick;
- roll barricade tape;
- rolls white vinyl tape;
- rolls yellow vinyl tape;
- radiological and hazardous waste labels;
- spill response guide;

In addition to the items contained in the spill kit, the following items should also be available in the work area:

- A/B/C fire extinguishers; and
- emergency shower and eyewash stations (as applicable).

## **12.5 Unanticipated Hazards or Conditions**

Unanticipated hazards or conditions encountered during this project will be managed as follows: In the event unanticipated hazards or conditions are encountered, the project activities will pause to assess the potential hazard or condition. The potential hazard or condition will be evaluated to determine the severity or significance of the hazard or condition and whether the controls on the project are sufficient to address the hazard or condition. Based on this initial evaluation, a determination will be made whether to proceed with controls currently in place; segregate the hazard or condition from the project activity, if it can be done safely; or curtail operations to address the unexpected hazard or condition. Concurrence to proceed down the selected path must be obtained from the K-H ER Program Manager or designee. Note: "Unanticipated Hazards or Conditions" do not replace conditions that require emergency response, rather, they ensure that all work is performed based on an informed approach in regards to all potential hazards.

## **13.0 SPILL CONTROL**

### **13.1 Spill Response Planning**

The Spill Response Plan is designed to establish a program/plan to optimize a safe and informed response to incidental and emergency situations with the intent of protecting remediation site project personnel, collocated workers, the public, the environment, and property in the event of spills, fire, or explosion. All spills will be addressed in accordance with Chapter 9 of 1-MAN-019-CMM-001, *Chemical Management Manual*, and 1-C90-EPR-SW.03, *Containment of Spills within the Rocky Flats Drainages*. If applicable, reporting will be conducted in accordance with the RFETS Administrative Procedures Manual, 1-D97-ADM-16.01, *Occurrence Reporting Process*.

### **13.2 Incidental Spill Operation**

#### ***Incidental Spill Definition:***

Incidental spills are those where the substance can be safely absorbed, neutralized, or otherwise controlled by employees in the immediate release area at the time of the release. In addition, the release does not have the potential to become an emergency within a short time frame.

Spills considered as incidental include diesel fuel, gasoline, hydraulic fluid, or motor oil spills. Criteria that must be met prior to incidental release response actions include:

- Personnel have warned others and isolated the area to prevent vehicle traffic through the area and minimize personnel exposures;
- The RFETS Shift Superintendent and KH Project Manager have been notified and provided with the following information;
- Exact location of the spill;
- Type of spill;
- Volume of the spill;

- Time of the spill;

Response actions to be taken:

- All materials or equipment used during the response is compatible with the substance spilled.
- The Shift Superintendent or a representative from the RFETS emergency response team is at the site to observe the spill response and cleanup;

Incidental Spill Response Actions:

- In the case of liquid spills such as hydraulic fluid, motor oil, gasoline or diesel fuel, absorbent pads or materials will be used to contain and cleanup the spill. Absorbent materials will be properly packaged and handled in accordance with 1-PRO-WGI-001, *Waste Characterization, Generation, and Packaging*, and 4-D99-WO-1100, *Solid Radioactive Waste Packaging*.

Post incidental spill response will include:

- Ensuring the proper reporting per 1-MAN-019-CMM-001, *Chemical Management Manual* and 1-D97-ADM-16.01, *Occurrence Reporting Process*.
- Conducting a briefing to address the cause of the spill, methods of preventing future spills, and ways to improve readiness and response.

### **13.3 Emergency Spill Operation**

Emergency Response Definition:

A response effort by personnel from outside the immediate release area, or by other designated responders to a release that results, or is likely to result, in an uncontrolled release of a hazardous substance. An emergency response is required in the following situations:

- The responders are not in the immediate response area.
- The release requires emergency evacuation of employees in the area.
- The material has a NFPA health, fire, or reactivity hazard rating of 3 or 4.
- The release poses a serious threat of fire or explosion (propane or NFPA fire hazard rating of 3 or 4).
- The release may cause high levels of exposure to toxic substances.
- There is uncertainty that the employees in the work area can safely handle the severity of the hazard with the available PPE and equipment.

Emergency Spill Response Actions:

- Personnel should warn others and evacuate the area to a safe upwind location.
- Isolate the area to prevent vehicle traffic through the area and minimize personnel exposures.

- Notify the RFETS Shift Superintendent and KH Project Manager and provide them with the following information.
  - Exact location of the spill.
  - Type of spill.
  - Volume of the spill.
  - Time of the spill.
  - Call 966-2911 or use radio channel 2911 and report the release.

## **14.0 RECORD KEEPING REQUIREMENTS**

All training and field experience will be verified and the SSO shall maintain records in the Project Support Trailer.

### **14.1 Daily Health and Safety Meetings**

Daily/shift plan-of-the-day (POD) and safety briefings for site employees will be conducted. The briefings will address the days planned activities, reminders of safety responsibilities; new chemicals brought on site, lessons learned, and any safety concerns. These meetings will be documented by the SSO. Documentation will be in a written format that states the subjects covered, the signature and title of the presenter, and signatures of all employees attending the meeting.

### **14.2 Accident/Incident Reporting**

All accidents, incidents, and near misses will be immediately reported to the Field Supervisor and the Project Manager. It is the Project Manager's responsibility to ensure that the appropriate personnel are notified of the accident/incident. In addition, RFETS requires DOE form F5484.3, "Individual Accident/Incident Report" to be completed for all first aid incidents and the following "Recordable" occupational injuries or illnesses as defined below.

OCCUPATIONAL INJURY is any injury such as a cut, fracture, sprain, or amputation that results from a work accident or from an exposure involving a single incident in the work environment that requires more than standard first aid.

Note: Conditions resulting from animal or insect bites, or one-time exposure to chemicals, are considered injuries.

OCCUPATIONAL ILLNESS of an employee is any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases that may be caused by inhalation, absorption, ingestion, or direct contact with a toxic material.

PROPERTY DAMAGE LOSSES of \$1,000 or more are reported as follows: Accidents that cause damage to



DOE property, regardless of fault, or accident wherein DOE may be liable for damage to a second party, are reportable if damage is \$5,000 or more. Include damage to facilities, inventories, equipment, and properly parked motor vehicles. Exclude damage resulting from a DOE-reportable vehicle accident.

GOVERNMENT MOTOR VEHICLE ACCIDENTS resulting in damages of \$250 or more, or involving injury, are reported unless the government vehicle is not at fault, damage of less than \$250 is sustained by the government vehicle, and no injury is inflicted on the government vehicle occupants.

### **14.3 Health and Safety Logbooks**

Separate health and safety logbooks with control numbers shall be maintained by Field Supervisors, SSO and HSS and will be turned in to the Project Manager once the project is completed. The Project Manager will then turn in the project logbooks and documents to the KH Project Manager who will then give them to the environmental records management group. Logged information will meet the requirements of MAN-066-COOP, *Site Conduct of Operations Manual*, Chapter 6.4.9, "Logs and Round Sheets" and shall include:

1. Summary of daily health and safety issues.
2. All measurements taken.
3. Types of monitoring conducted.
4. Description of unforeseen hazards, who the hazard or compensatory measure was mitigated by, how it was mitigated, and the time and date it was mitigated.
5. Safety infractions.
6. Accidents and injuries.
7. Other significant health and safety items.

**APPENDIX A**  
**Sample HASP Addenda**

## APPENDIX B

A job hazard analysis (JHA) is a job aid that helps integrate accepted safety and health principles and practices into a particular operation. In a JHA, each basic step of the job is examined to identify potential hazards and to determine the safest way to do the job.

Four basic stages in conducting a JHA are:

- selecting the job to be analyzed
- breaking the job down into a sequence of steps
- identifying potential hazards
- determining preventive measures to overcome these hazards

Factors to be considered in assigning a priority for analysis of jobs include:

- Accident frequency and severity: jobs where accidents occur frequently or where they occur infrequently but result in disabling injuries.
- Potential for severe injuries or illnesses: the consequences of an accident, hazardous condition, or exposure to harmful substance are potentially severe.
- Newly established jobs: due to lack of experience in these jobs, hazards may not be evident or anticipated.
- Modified jobs: new hazards may be associated with changes in job procedures.
- Infrequently performed jobs: workers may be at greater risk when undertaking non-routine jobs, and a JHA provides a means of reviewing hazards.

Figure 3-1 (JHA Form) of the IWCP Manual, MAN-071-IWCP illustrates the format to be used in preparing a JHA.

To help identify potential hazards, the job analyst may use questions such as these (this is not a complete list):

- Can any body part get caught in or between objects?
- Do tools, machines, or equipment present any hazards?
- Can the worker make harmful contact with objects?
- Can the worker slip, trip, or fall?
- Can the worker suffer strain from lifting, pushing, or pulling?
- Is the worker exposed to extreme heat or cold?
- Is excessive noise or vibration a problem?
- Is there a danger from falling objects?

- Is lighting a problem?
- Can weather conditions affect safety?
- Is harmful radiation a possibility?
- Can contact be made with hot, toxic, or caustic substances?
- Are there dusts, fumes, mists, or vapors in the air?

The final stage in a JHA is to determine ways to eliminate or control the hazards identified. The generally accepted measures, in order of preference, are:

### ***1. Eliminate the hazard***

This is the most effective measure. These techniques should be used to eliminate the hazards:

- Choose a different process
- Modify an existing process
- Substitute with less hazardous substance
- Improve environment (ventilation)
- Modify or change equipment or tools

### ***2. Contain the hazard***

If the hazard cannot be eliminated, contact might be prevented by using enclosures, machine guards, worker booths or similar devices.

### ***3. Revise work procedures***

Consideration might be given to modifying steps which are hazardous, changing the sequence of steps, or adding additional steps (such as locking out energy sources).

### ***4. Reduce the exposure***

These measures are the least effective and should only be used if no other solutions are possible. One way of minimizing exposure is to reduce the number of times the hazard is encountered. An example would be modifying machinery so that less maintenance is necessary. The use of appropriate personal protective equipment may be required. To reduce the severity of an accident, emergency facilities, such as eyewash stations, may need to be provided.

In listing the preventive measures, use of general statements such as "be careful" or "use caution" should be avoided. Specific statements which describe both what action is to be taken and how it is to be performed are preferable.

### APPENDIX C Project Phone List

Name	Company/Title	Phone	Pager	Cell
Anderson, Michael	Summit - Senior Engineer	3263	212-5631	
Bean, Curtis	K-H - Radiation Safety Manager	2069	212-3810	
Bemski, Mike	RMRS - Field Supervisor	4090	212-6271	3720
Blake, Chad	Omega - Radiological Engineer	5909	212-2079	
Broussard, Marla	K-H - Characterization & Data Management Coordination	6007	212-6261	
Burmeister, Mark	RMCI - Technical Manager	5891	212-6228	3750
Butler, Lane	K-H - ER Program Manager	5245	212-3017	
Casteneda, Norma	DOE - ER Projects	4226		
Cowdery, Craig	Washington Group - Engineer/Scientist	2506		
Cirillo, Russ	RMRS - Bldg. 891 Water Treatment/ Decontamination Facilities	5876	212-6192	3765
Demos, Nick	RMRS - Historical Release Report Coordination	4605	212-6159	3810
DiGregorio, Greg	RMRS - Quality Assurance	5688	212-6206	
Gonzalez, Andre	K-H - Health and Safety	6727	212-6636	
Greengard, Tom	SAIC - Hydrological Resources	5635	212-1968	
Griggs, Karen	Arcadia Consulting - Document Specialist	4743		
Horne, Alan	RMRS Corporate - Project Control Support	5644		
Lindsey, Tom	RMRS - Field Supervisor	5705	212-5681	3757
Lopez, Sherry	RMRS - ER Project Coordination	3753	212-6310	
Luker, Steve	RMCI - Quality Assurance	7291	212-6534	
Madore, Catherine	Parsons - Technical Support	3692	212-1779	
Mobley, Steve	K-H - Excavation Specialist	2538	212-5502	
Norland, Lee	K-H - Technical Support Manager	5223	212-1966	
Paris, Steve	RMCI - Senior Engineer	3656		
Parson, Gary	K-H - Excavation Specialist	4197	212-5508	
Primrose, Annette	K-H - Field Operation Manager	4385	212-6338	3801
Reeder, Dan	Summit - Statistical Specialist	3209		
Serreze, Susan	Arcadia Consulting - Industrial Area Closure Coordination	2677		
Shafer, Douglas	K-H - Project Controls Manager	5976	212-2677	
Spence, Tracey	RMRS - Field Project Coordination	4322	212-6575	3700
Strand, David	Arcadia Consulting - UBC Support	6422	212-2288	3745

## **APPENDIX D**

### **Heat and Cold Stress Guidelines**

## RFETS HEAT STRESS PROGRAM

## HEAT STRESS GUIDELINES FOR LIGHT WORK

(1)	(2)	(3)	(4)
WORK/REST	WBGT°F	WBGT°F	WBGT°F
Continuous	86	76	72
75/25%	87	77	73
50/50%	89	78.5	74.5
25/75%	90	79.9	75.9

## HEAT STRESS GUIDELINES FOR MODERATE WORK

(1)	(2)	(3)	(4)
WORK/REST	WBGT°F	WBGT°F	WBGT°F
Continuous	80	70	66
75/25%	82	72.4	68.4
50/50%	85	74.9	70.9
25/75%	88	77.9	73.9

## HEAT STRESS GUIDELINES FOR HEAVY WORK

(1)	(2)	(3)	(4)
WORK/REST	WBGT°F	WBGT°F	WBGT°F
Continuous	77	67	63
75/25%	78	68.6	64.6
50/50%	82	72.2	68.2
25/75%	86	76	72

(1) No Personal Protective Equipment

(2) One pair coveralls (Anti C), modesty garments, gloves, hood, shoe covers.... (Level D Haz Mat PPE)

(3) Two pair coveralls (Anti C), modesty garments, gloves, hood, shoe covers....

or

One pair coveralls (Anti C), modesty garments, gloves, hood, respirator. (Level C Haz Mat PPE)

(4) Two pair coveralls (Anti C), modesty garments, gloves, hood, shoe covers, respirator. (Level A&B Haz Mat PPE)

# Windchill Index

Wind Speed in mph	ACTUAL THERMOMETER READING (F)									
	50	40	30	20	10	0	-10	-20	-30	-40
	EQUIVALENT TEMPERATURE (F)									
calm	50	40	30	20	10	0	-10	-20	-30	-40
5	48	37	27	16	6	-5	-15	-26	-36	-47
10	40	28	16	4	-9	-21	-33	-46	-58	-70
15	36	22	9	-5	-18	-36	-45	-58	-72	-85
20	32	18	4	-10	-25	-39	-53	-67	-82	-96
25	30	16	0	-15	-29	-44	-59	-74	-88	-104
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109
35	27	11	-4	-20	-35	-49	-67	-82	-98	-113
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116
Over 40 mph (little added effect)	LITTLE DANGER (for properly clothed person)				INCREASING DANGER (Danger from freezing of exposed flesh)			GREAT DANGER		



Threshold Limit Values Work/Warm-up Schedule for Four-Hour Shifts

Air Temperature—Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C (approx.)	°F (approx.)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to -28°	-15° to -19°	(Norm. Breaks) 1		(Norm. Breaks) 1		75 min	2	55 min	3	40 min	4
-29° to -31°	-20° to -24°	(Norm. Breaks) 1		75min	2	55 min	3	40 min	4	30 min	5
-32° to -34°	-25° to -29°	75 min	2	55 min	3	40 min	4	30 min	5	Non-emergency work should cease	
-35° to -37°	-30° to -34°	55 min	3	40 min	4	30 min	5	Non-emergency work should cease			
-38° to -39°	-35° to -39°	40 min	4	30 min	5	Non-emergency work should cease					
-40° to -42°	-40° to -44°	30 min	5	Non-emergency work should cease							
-43° & below	-45° & below	Non-emergency work should cease									

- Schedule applies to any 4-hour work period with moderate to heavy work activity, with warm-up periods of ten (10) minutes in a warm location and with an extended break (e.g., lunch) at the end of the 4-hour work period in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule one step lower. For example, at -35°C (-30°F) with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (Step 5).
- The following is suggested as a guide for estimating wind velocity if accurate information is not available:  
5 mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.
- If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be: 1) special warm-up breaks should be initiated at a wind chill cooling rate of about 1750 W/m<sup>2</sup>; 2) all non-emergency work should have ceased at or before a wind chill of 2250 W/m<sup>2</sup>. In general, the warmup schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual temperatures in the colder ranges because windy conditions rarely prevail at extremely low temperatures.
- TLVs apply only for workers in dry clothing.

Adapted from Occupational Health &amp; Safety Division, Saskatchewan Department of Labour.